

# Načrtovanje elektronike za EMC



Univerza v Ljubljani  
Fakulteta za elektrotehniko  
Katedra za elektroniko



Laboratorij za fotovoltaiko  
in optoelektroniko

ISKRAEMECO + -



KEYSIGHT  
TECHNOLOGIES



Texas Instruments



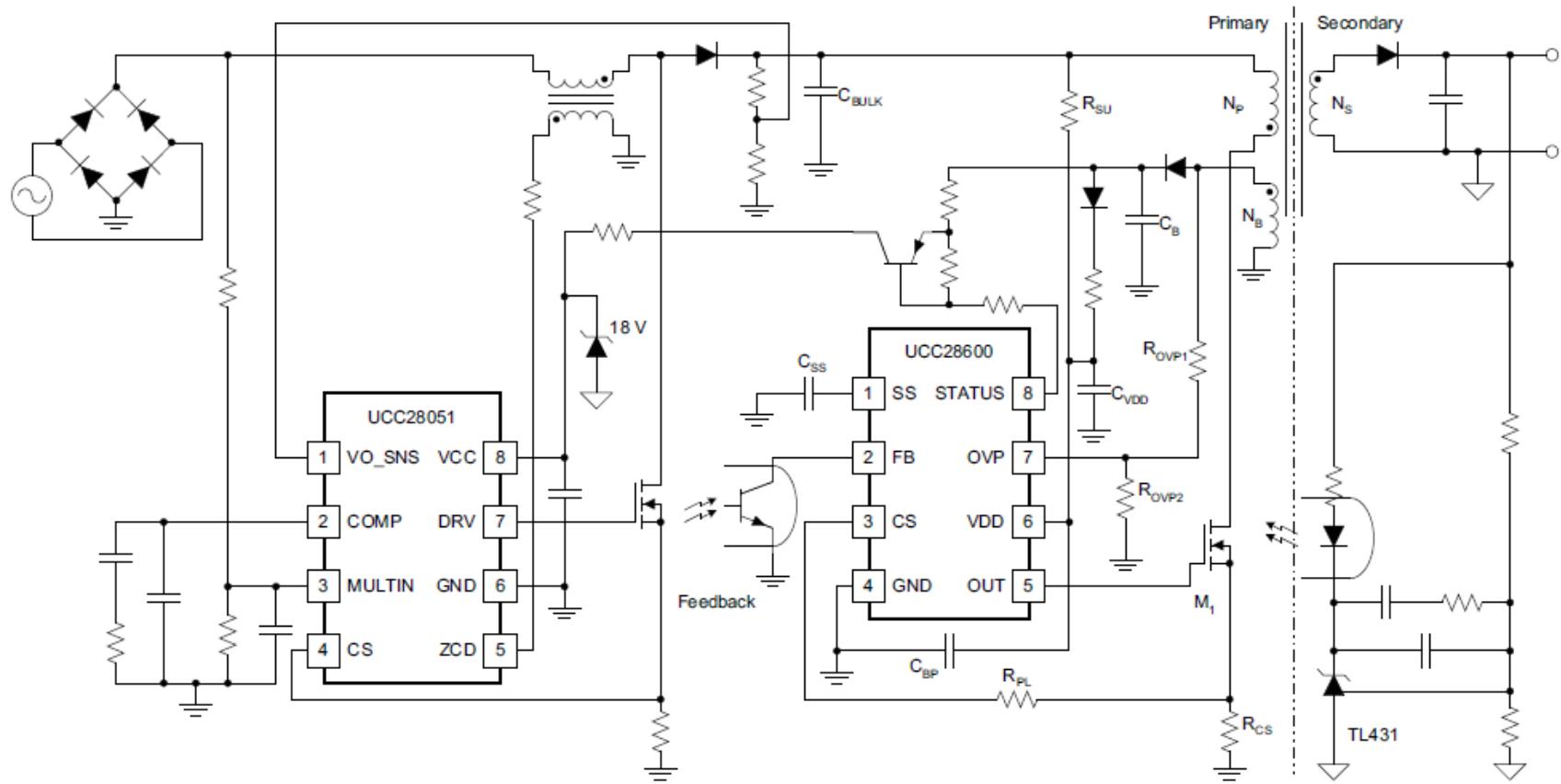
## vsako sredo ob 17h v P3-C0

Analiza in rezultati EMC delavnice 2017

Marko Jankovec, Leopold Filipič

## Izziv

Stikalni napajalnik 230V/20V za napajanje elektronskega števca



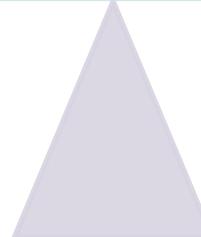


# Izziv

- Stikalni napajalnik iz 230V na 20V, maksimalna moč 10 W.

UCC28600  
(MOS)

UCC28720  
(BJT)



# Vzpodbuda

## Iskraemeco

- 500 €
- Elektromaterial za delavnico

## MAHLE letrika

- 500 €

## SIQ

- 2 uri meritev v laboratoriju (tržna cena 360 €)
- Vremensko postajo [OREGON RAR213HG.](#)

## Wurth elektronik

- Elektromaterial za delavnico
- [Energy Harvesting Demokit Solution To Go](#)

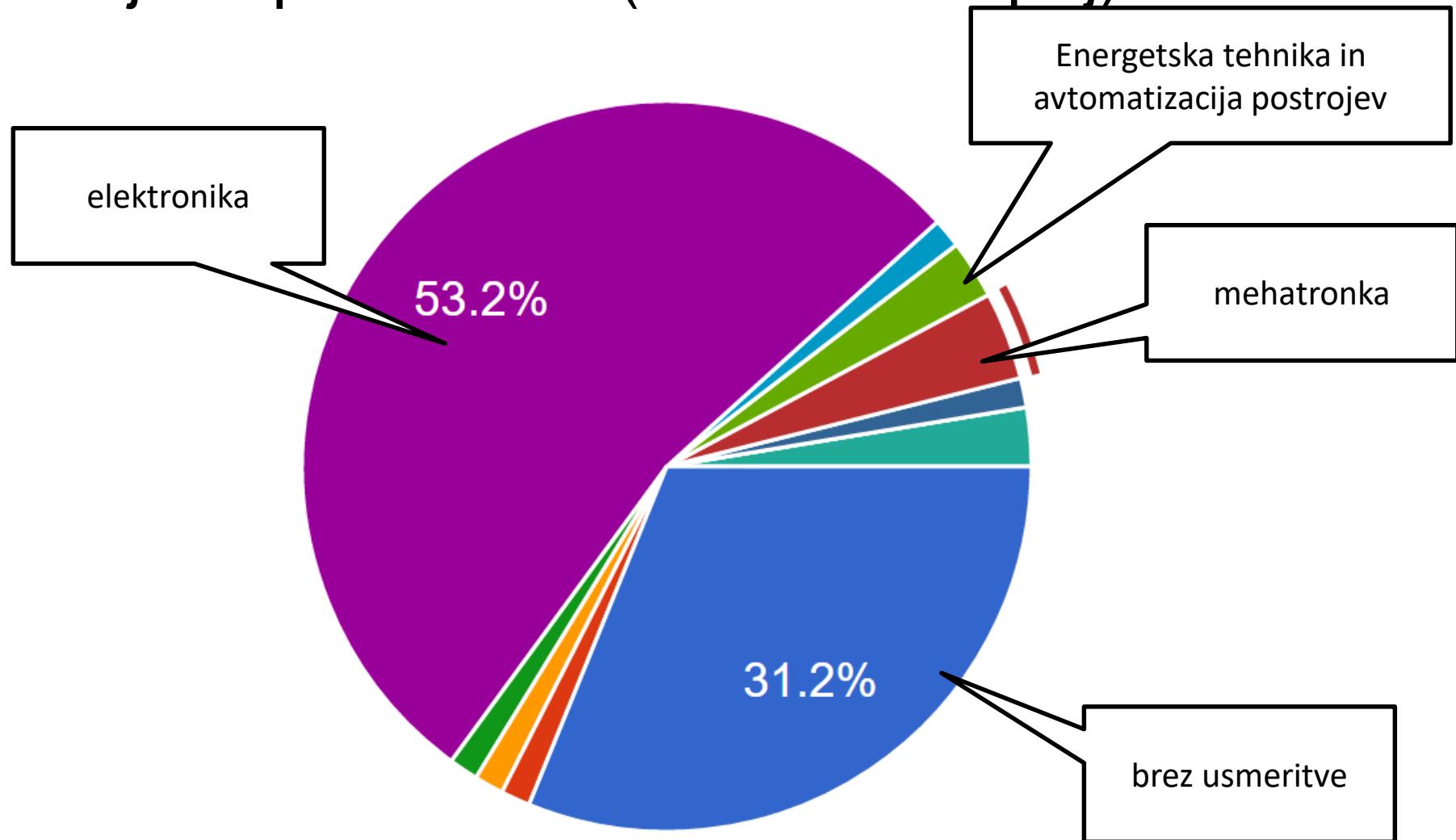
## Amitech

- Keysight multimeter v vrednosti 200 €
- Meritve z detectusom

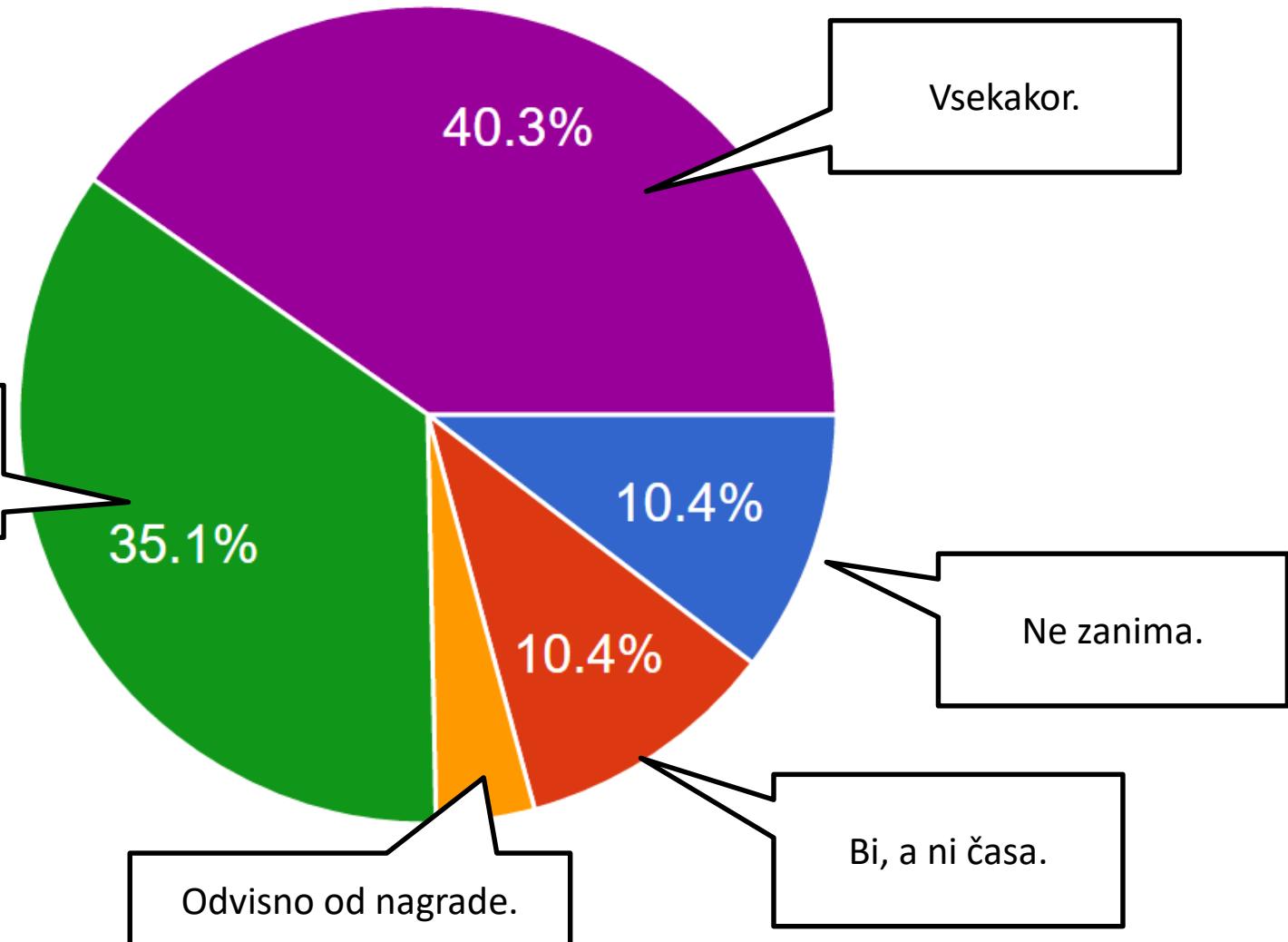
## HT-Eurep

- 2 Silabs razvojni plošči

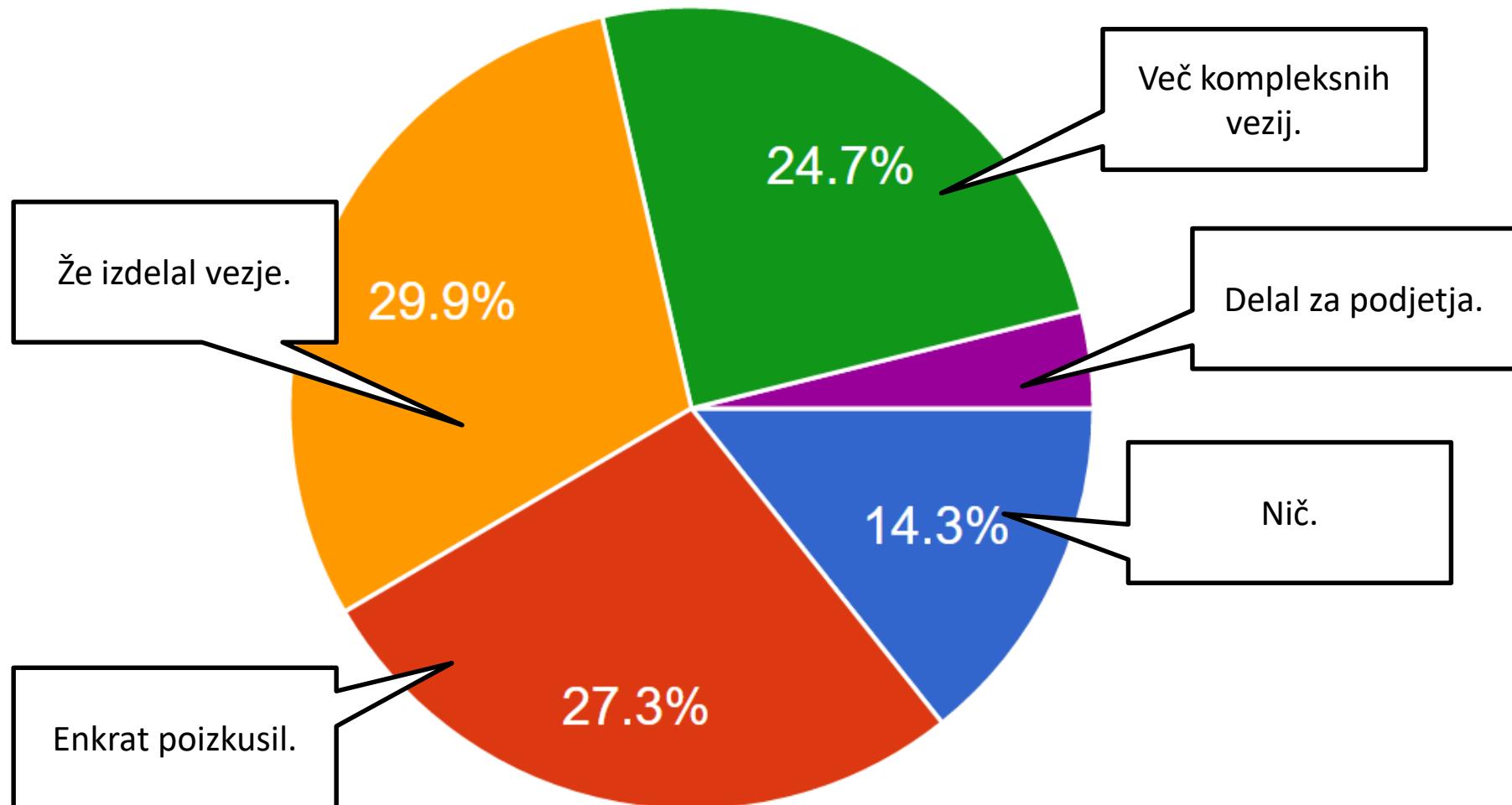
# Prijave po smereh (97 vseh skupaj)



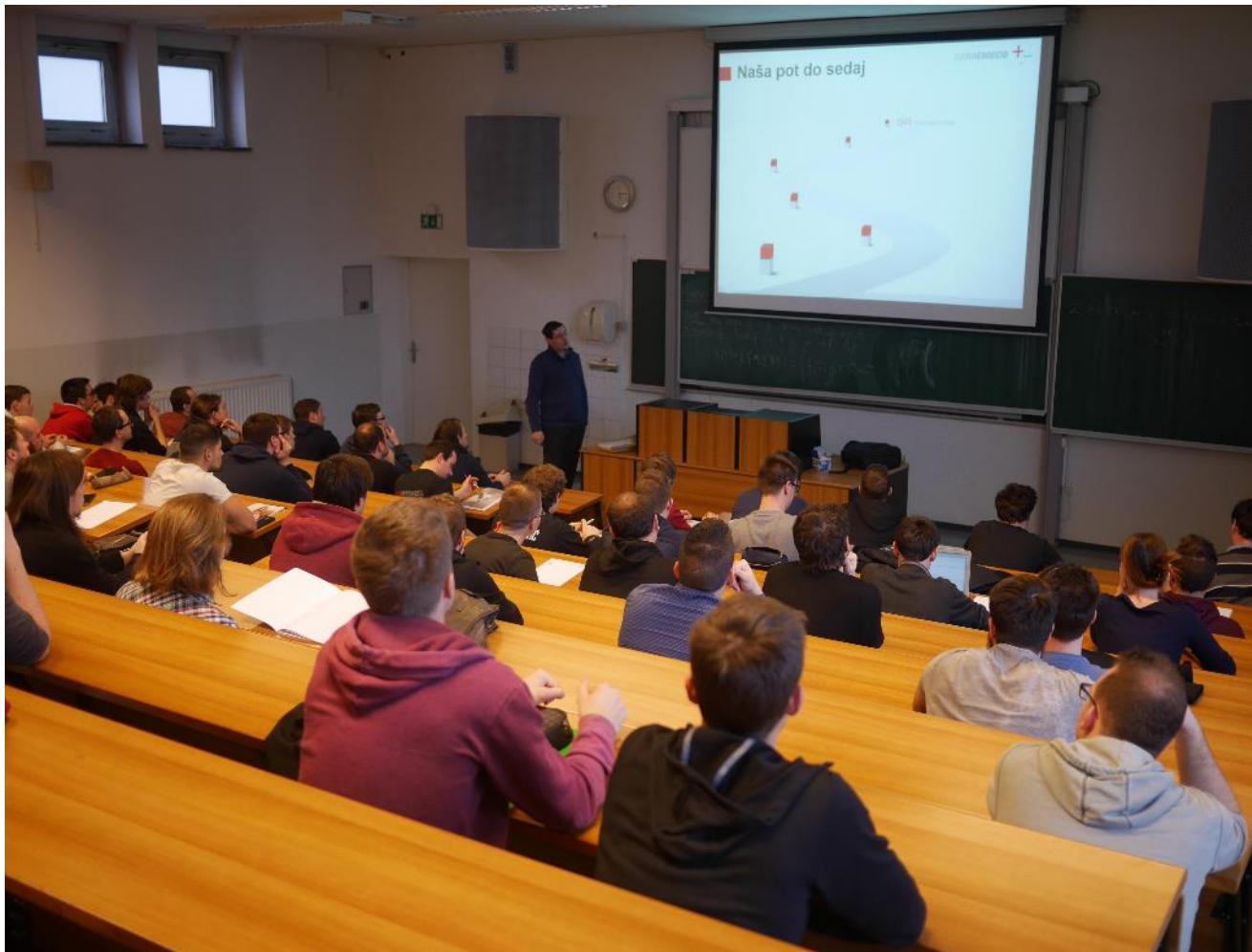
# Sodelovanje pri tekmovanju



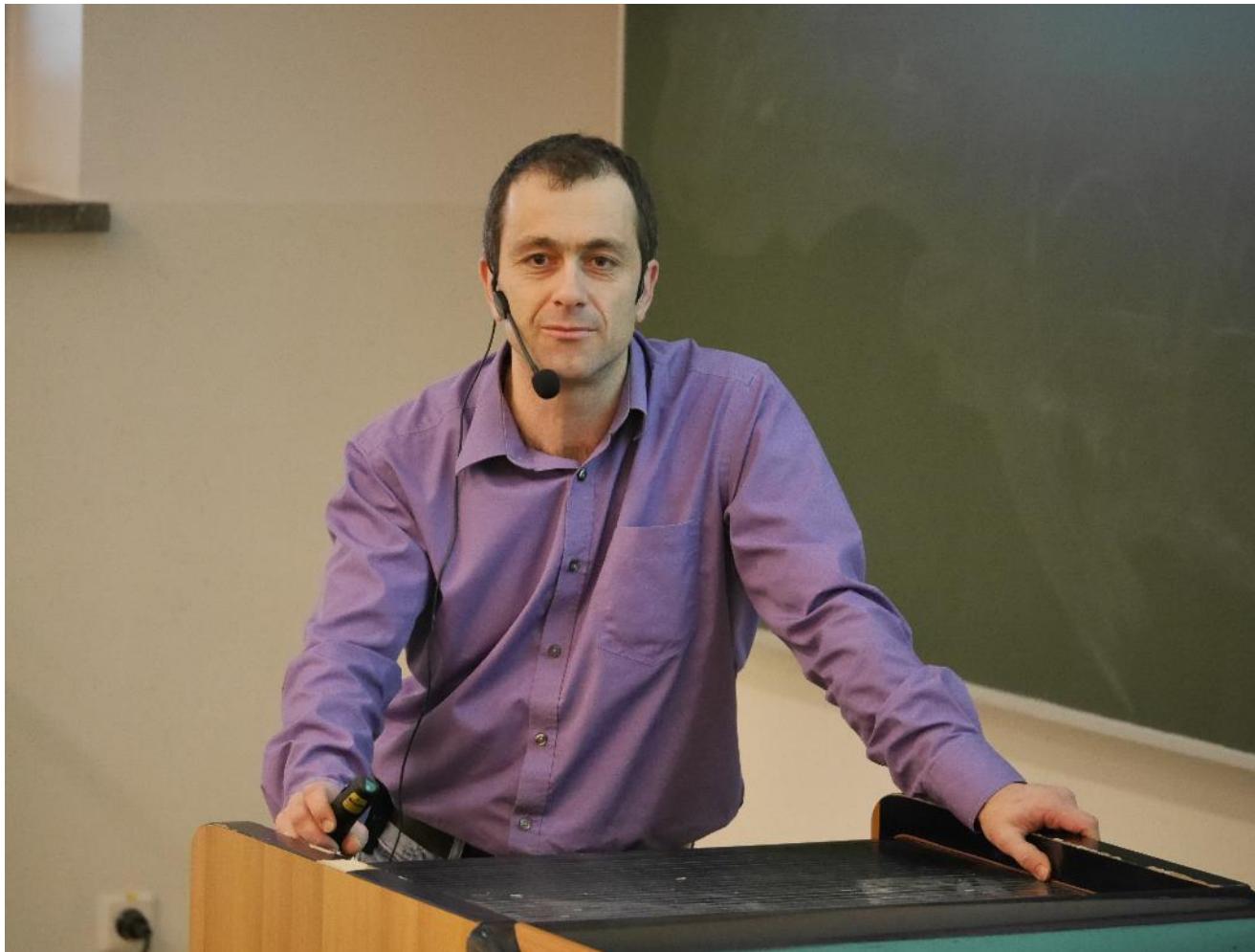
# Pretekle izkušnje z načrtovanjem TIV



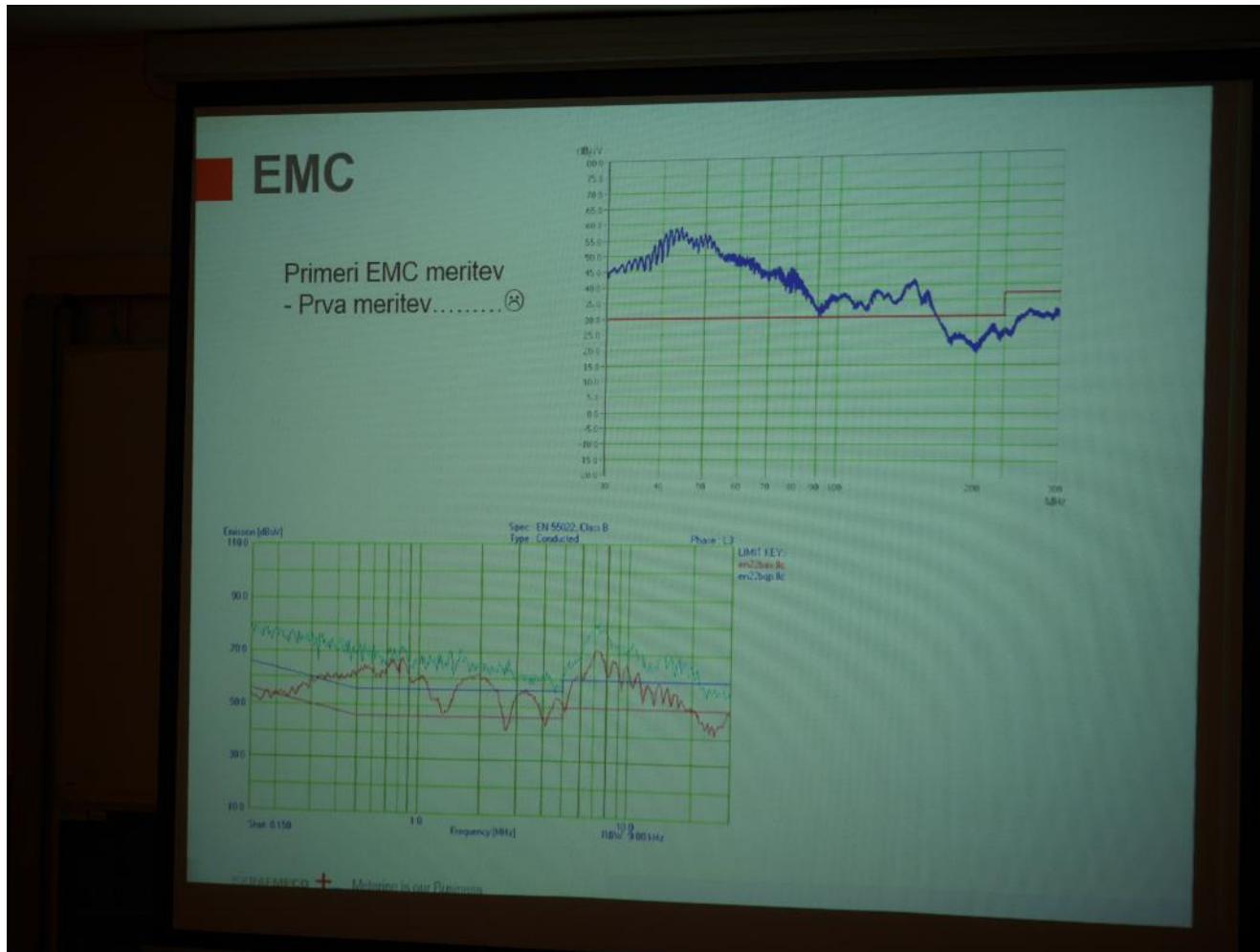
# Predavanja



# Predavanja



# Tudi izkušeni načrtovalci grešijo



# Predavanja



# Predavanja



# Predavanja



# Predavanja



# Predavanja



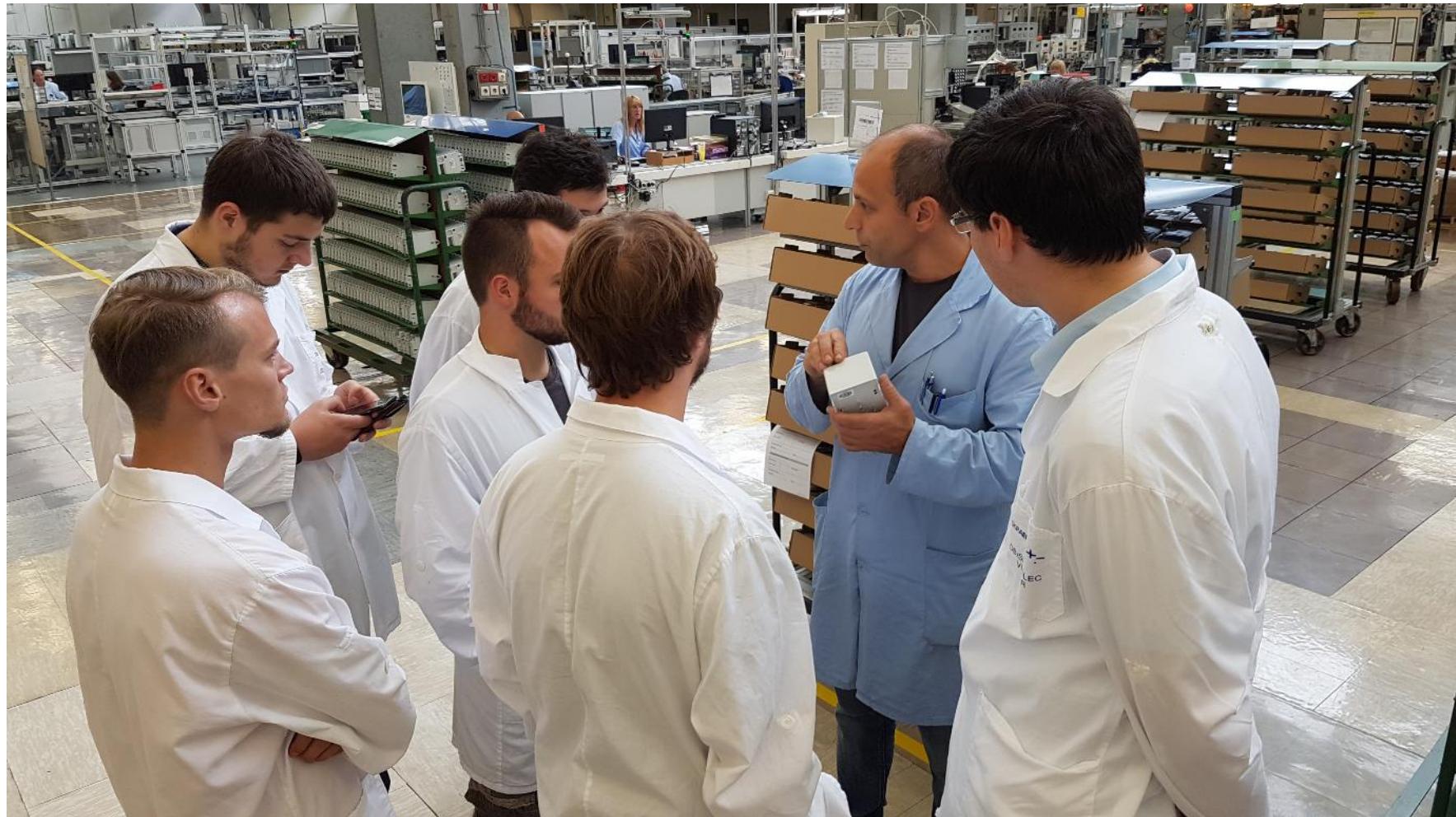
# Ekskurzija v Iskraemeco



# Ekskurzija v Iskraemeco



# Ekskurzija v Iskraemeco



# Ekskurzija v Iskraemeco



# Ekskurzija v Iskraemeco



# Ekskurzija v SIQ



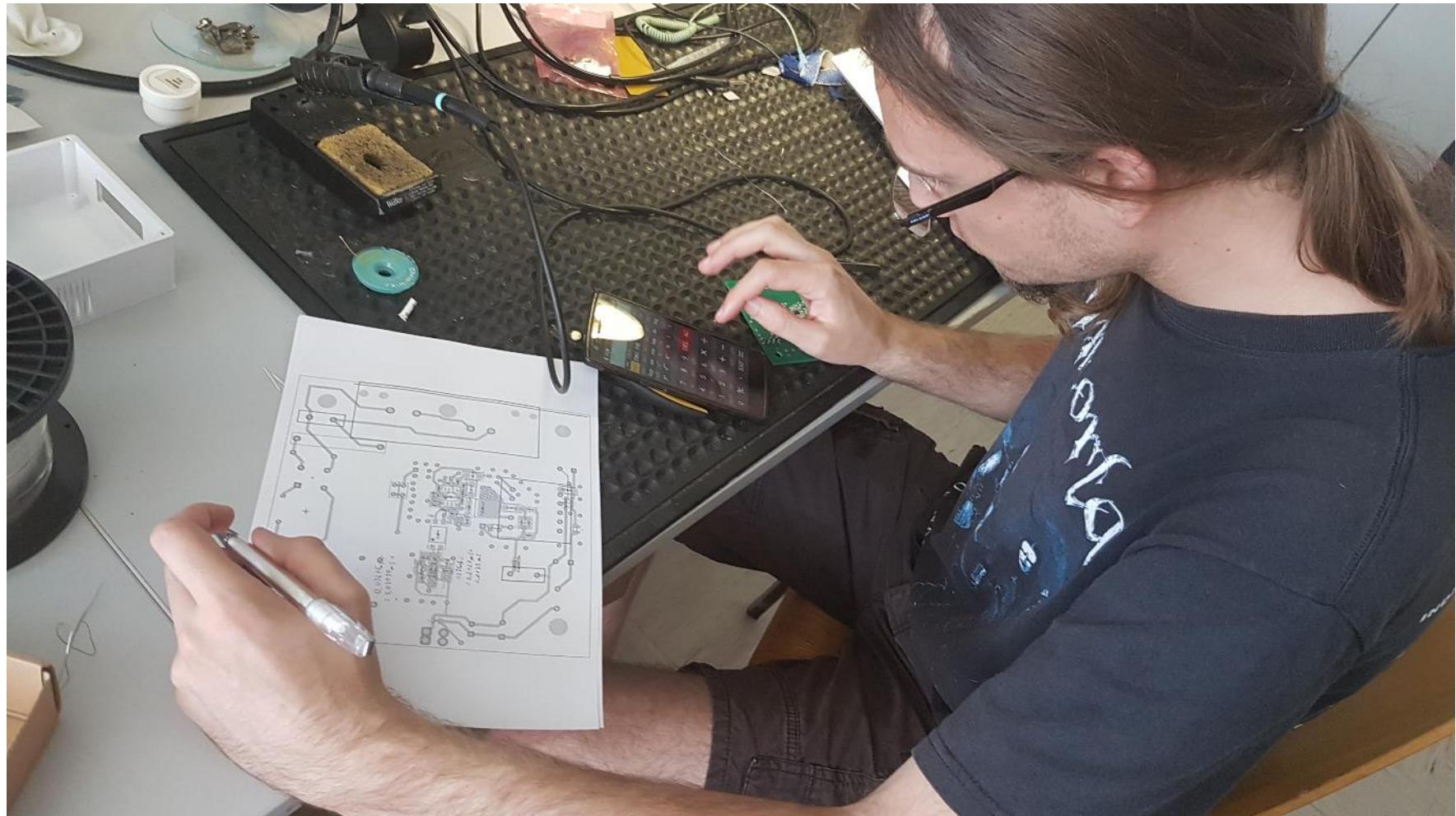
# Ekskurzija v SIQ



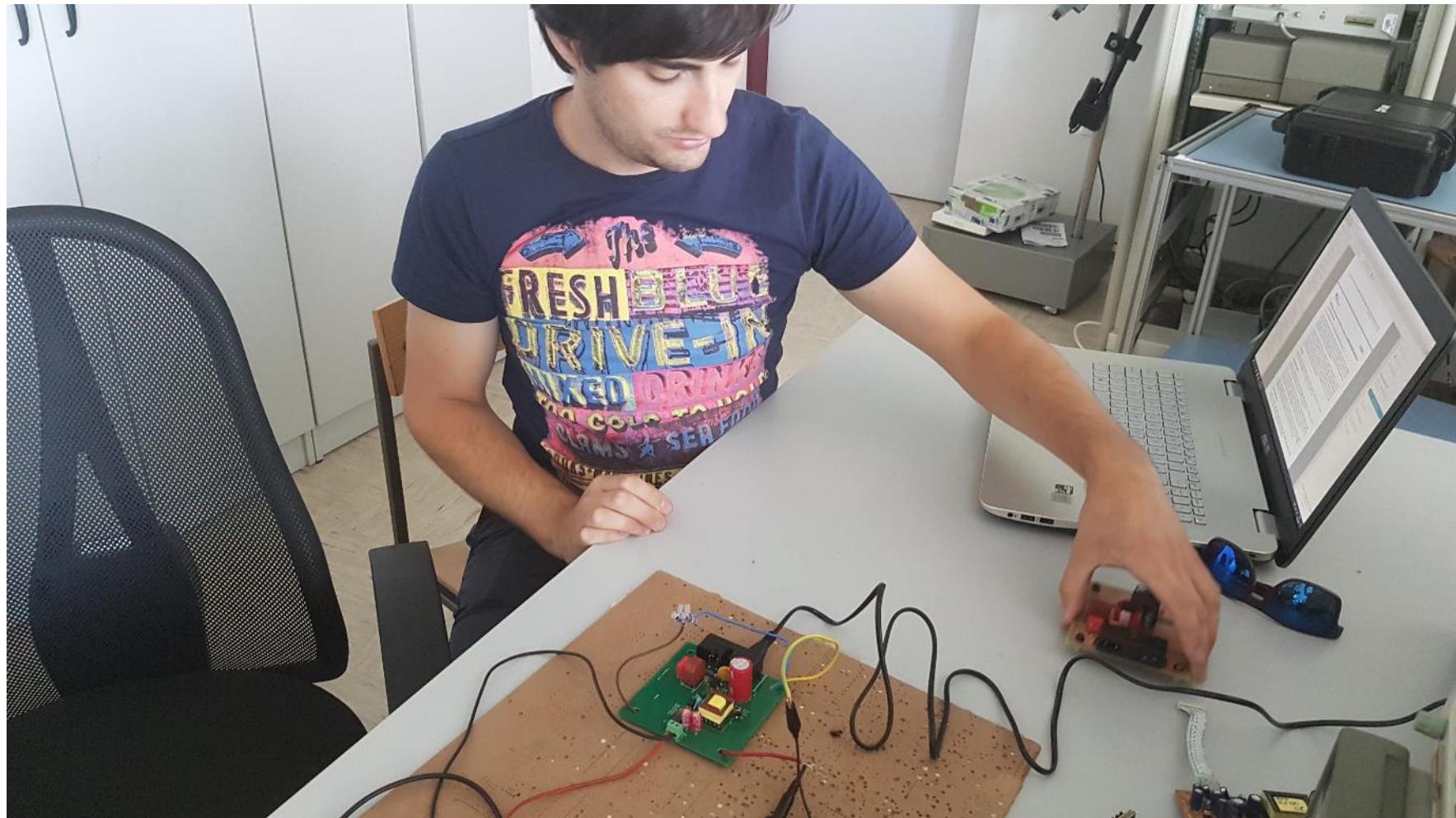
# Nabiranje materiala



# Gradnja projektov



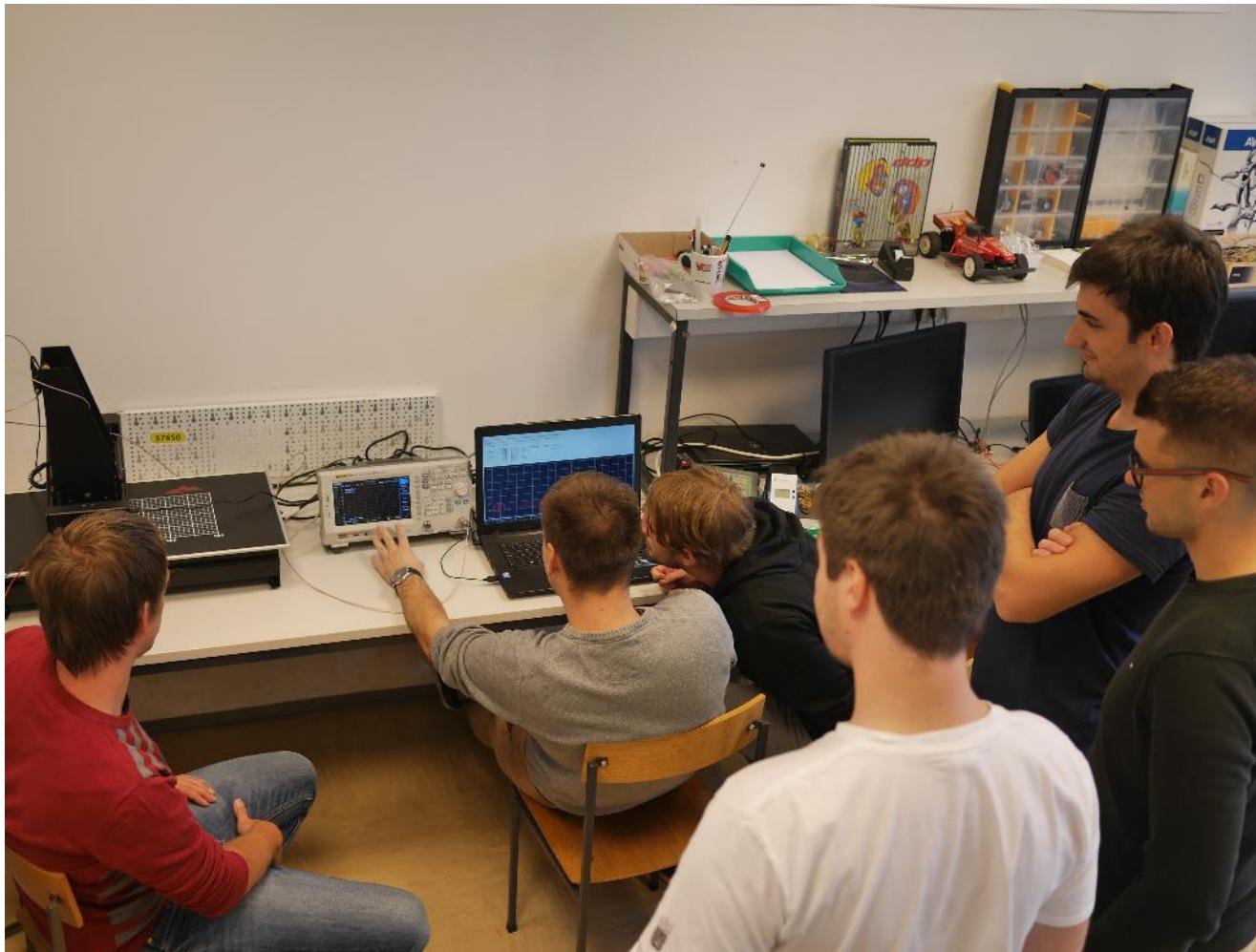
# Gradnja projektov



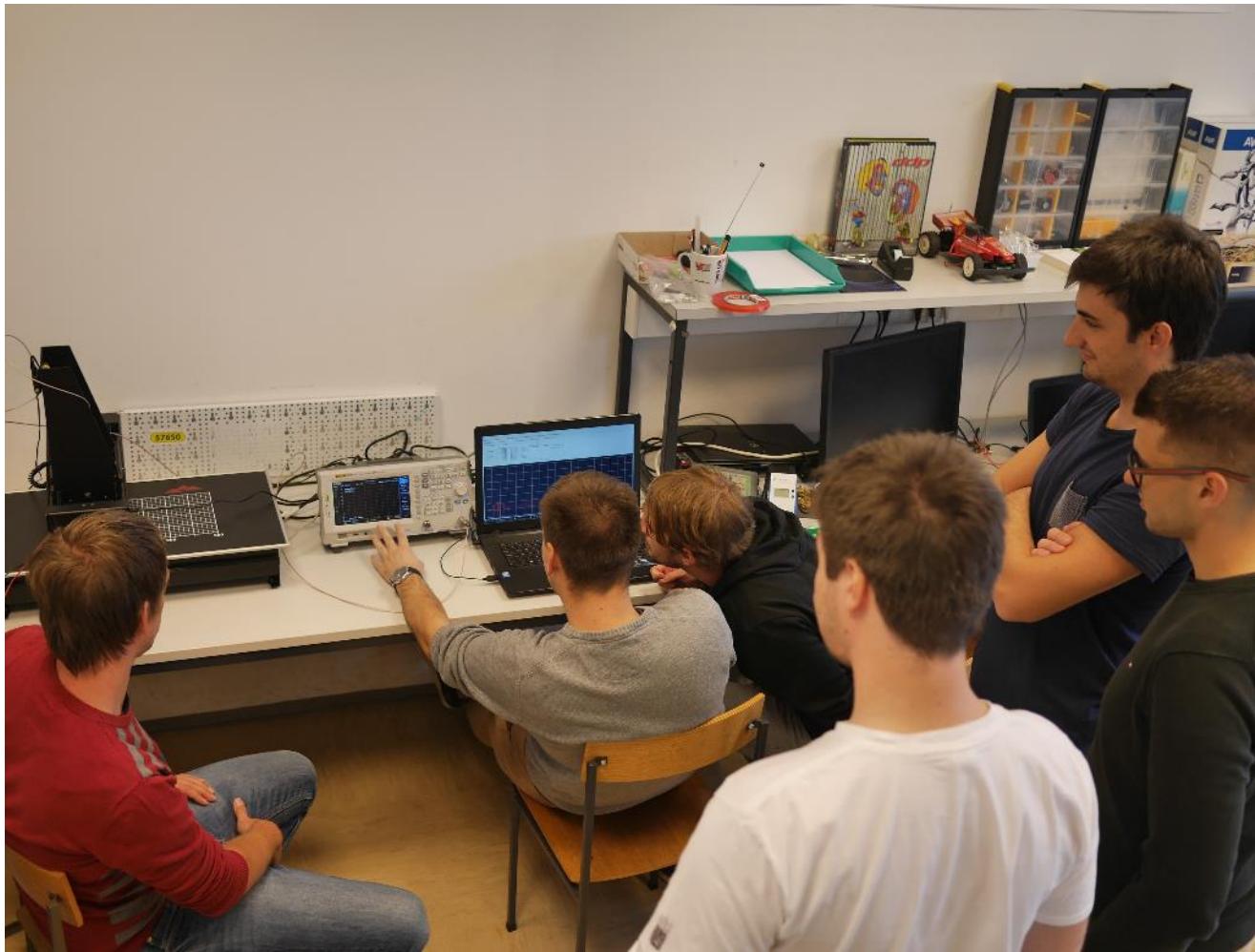
# Gradnja projektov



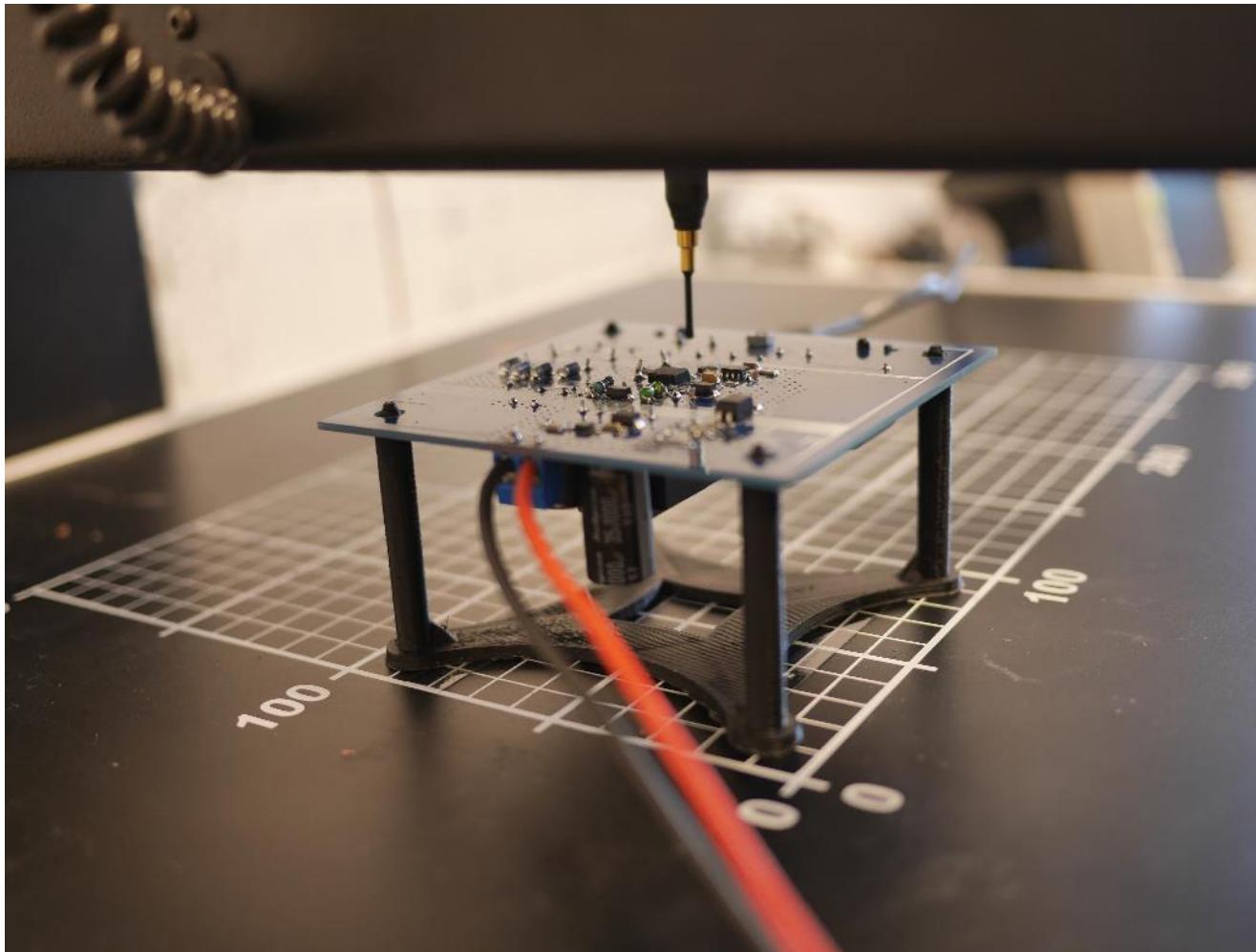
# Merjenje na detectusu



# Merjenje na detectusu



# Merjenje na detectusu



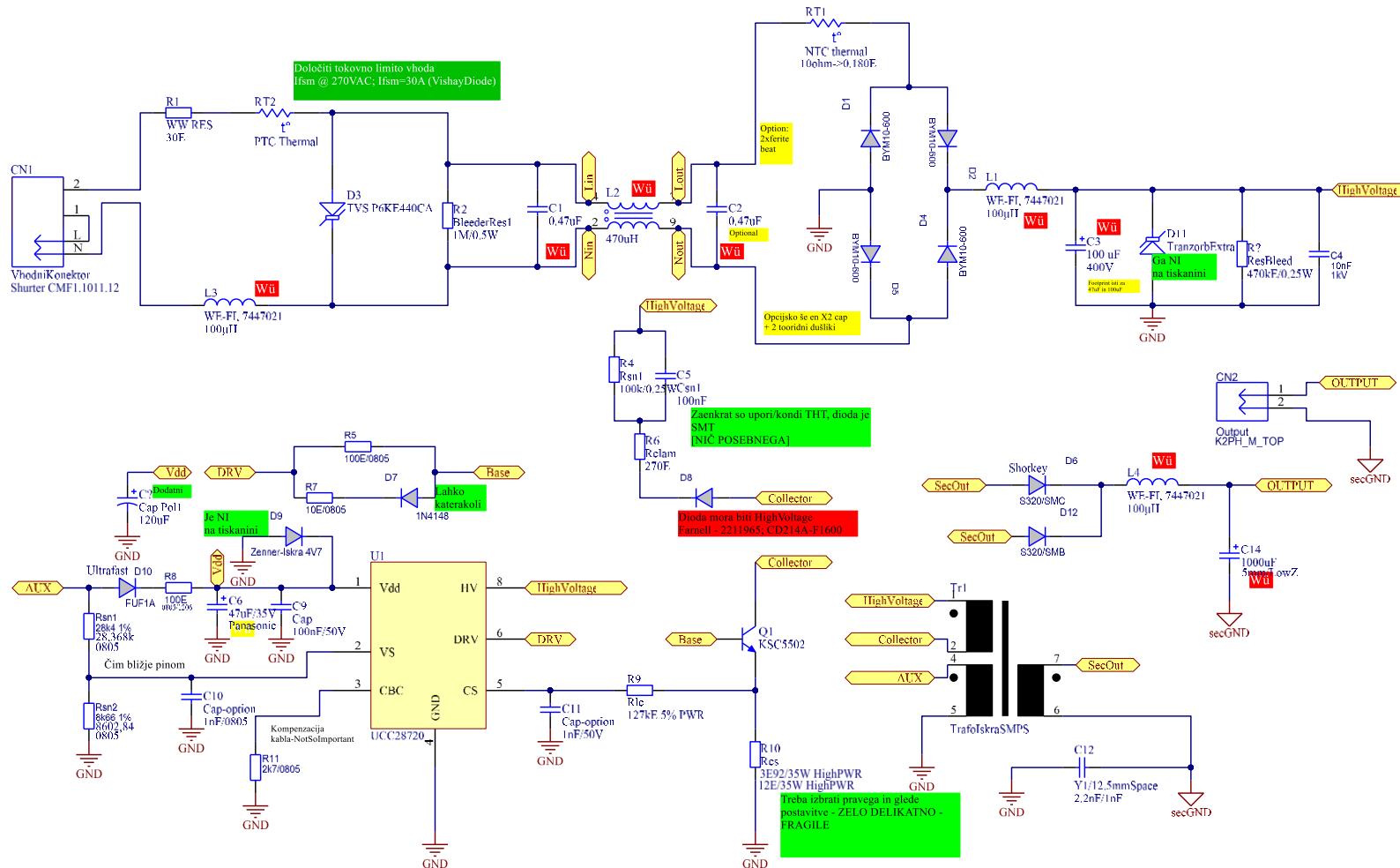
# Analiza rezultatov



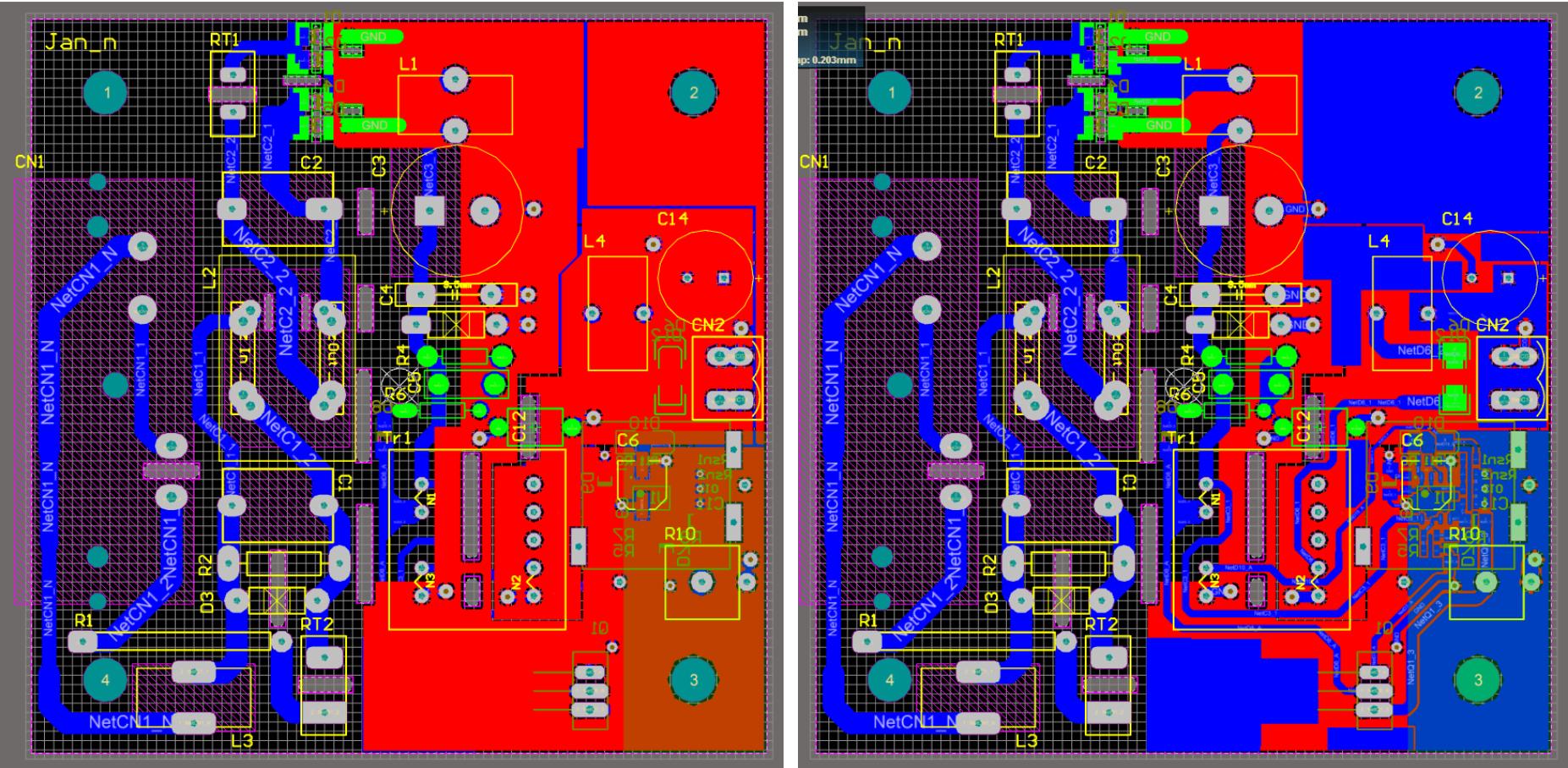
# Tekmovalci

- 23 študentov je naročilo material za projekt
- Od tega je uspešno izdelalo in oddalo projekt 7 študentov
  - › Jan Korošec, VS elektronika, 2. letnik
  - › Janez Govednik, MAG elektronika, 2. letnik
  - › Blaž Strojin, MAG elektronika, 2. letnik
  - › Žiga Korošak, MAG elektronika, 1. letnik
  - › Igor Strojinc, MAG elektronika, 1. letnik
  - › Luka Rupar, MAG elektronika, 1. letnik
  - › Jernej Strmec, MAG elektronika, 1. letnik

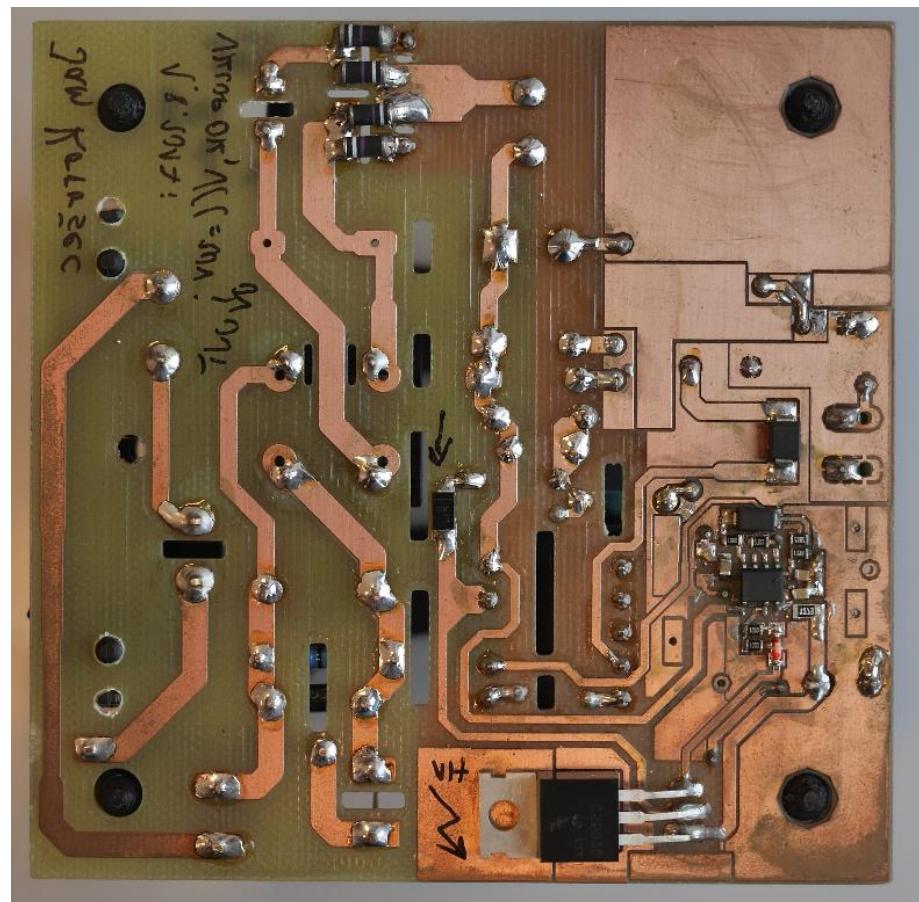
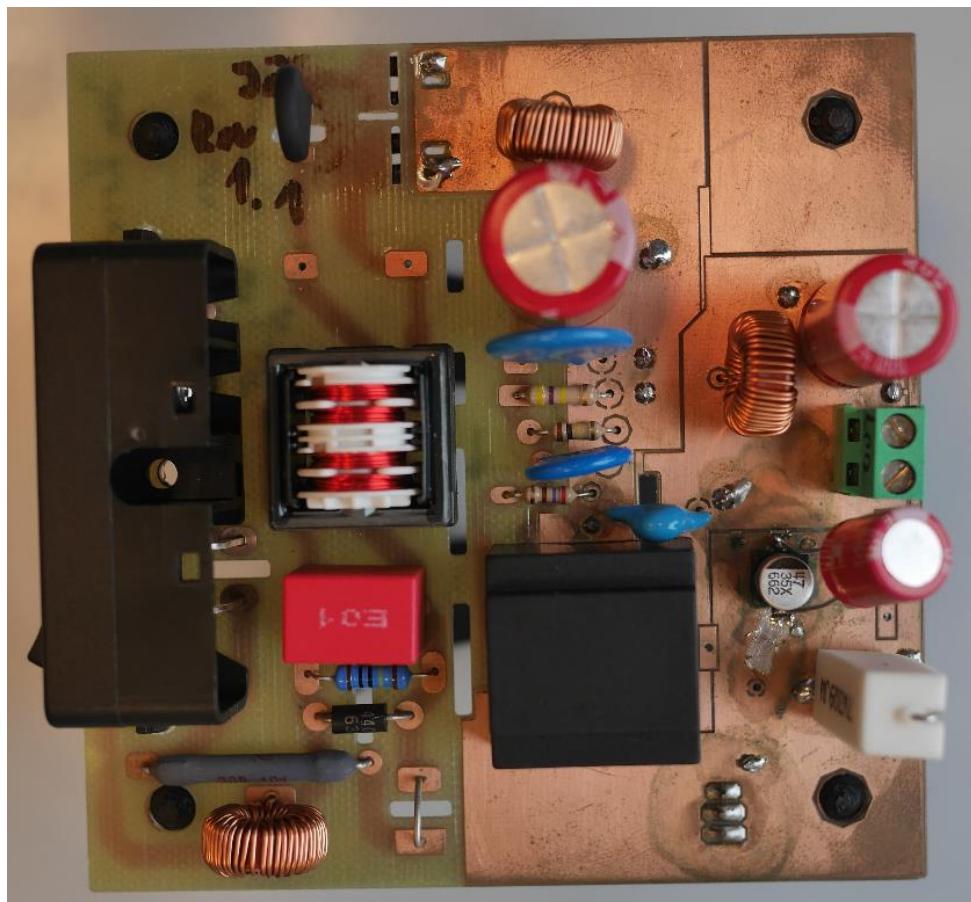
# Jan Korošec - shema



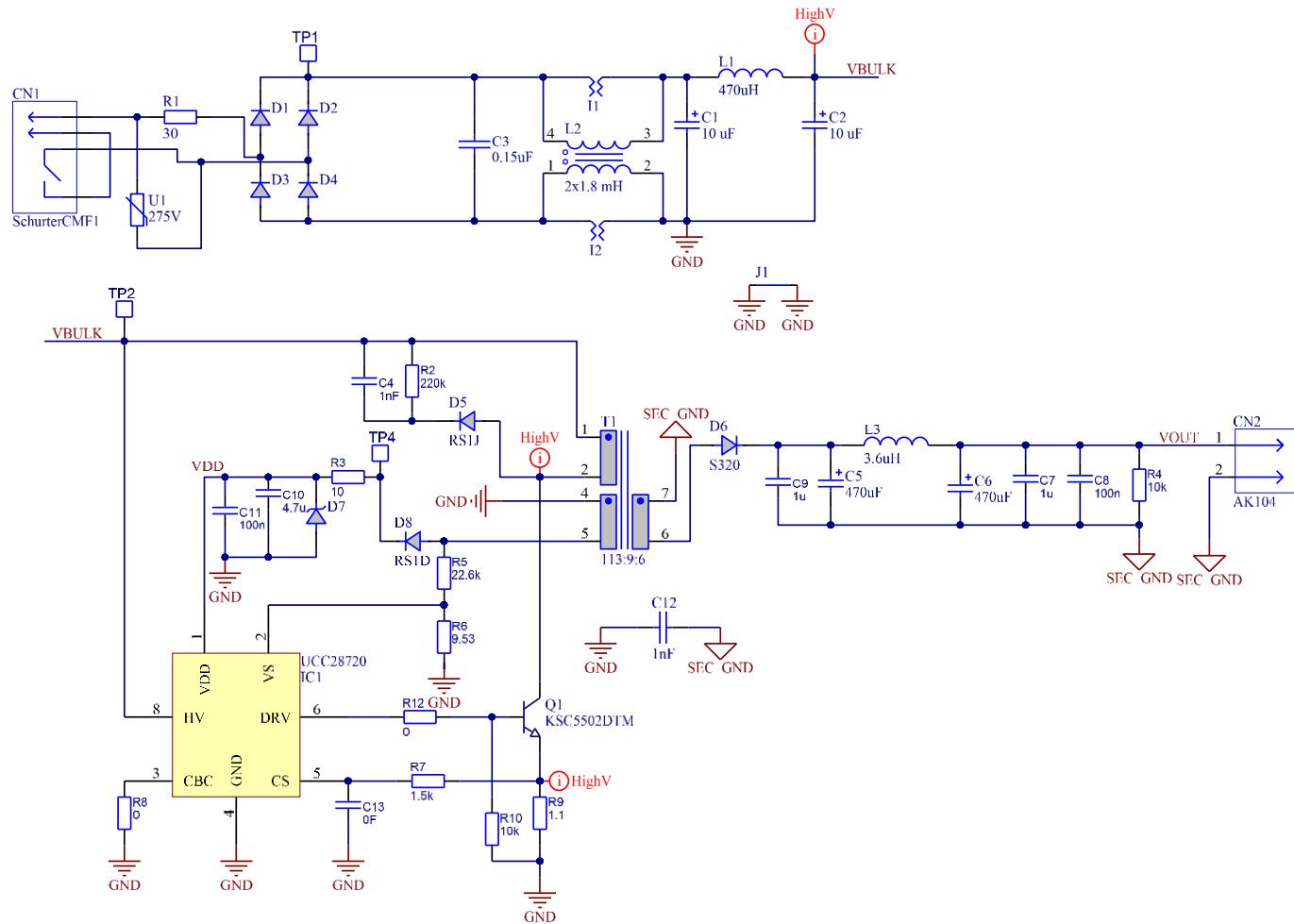
# Jan Korošec – načrt TIV



# Jan Korošec – izdelano TIV

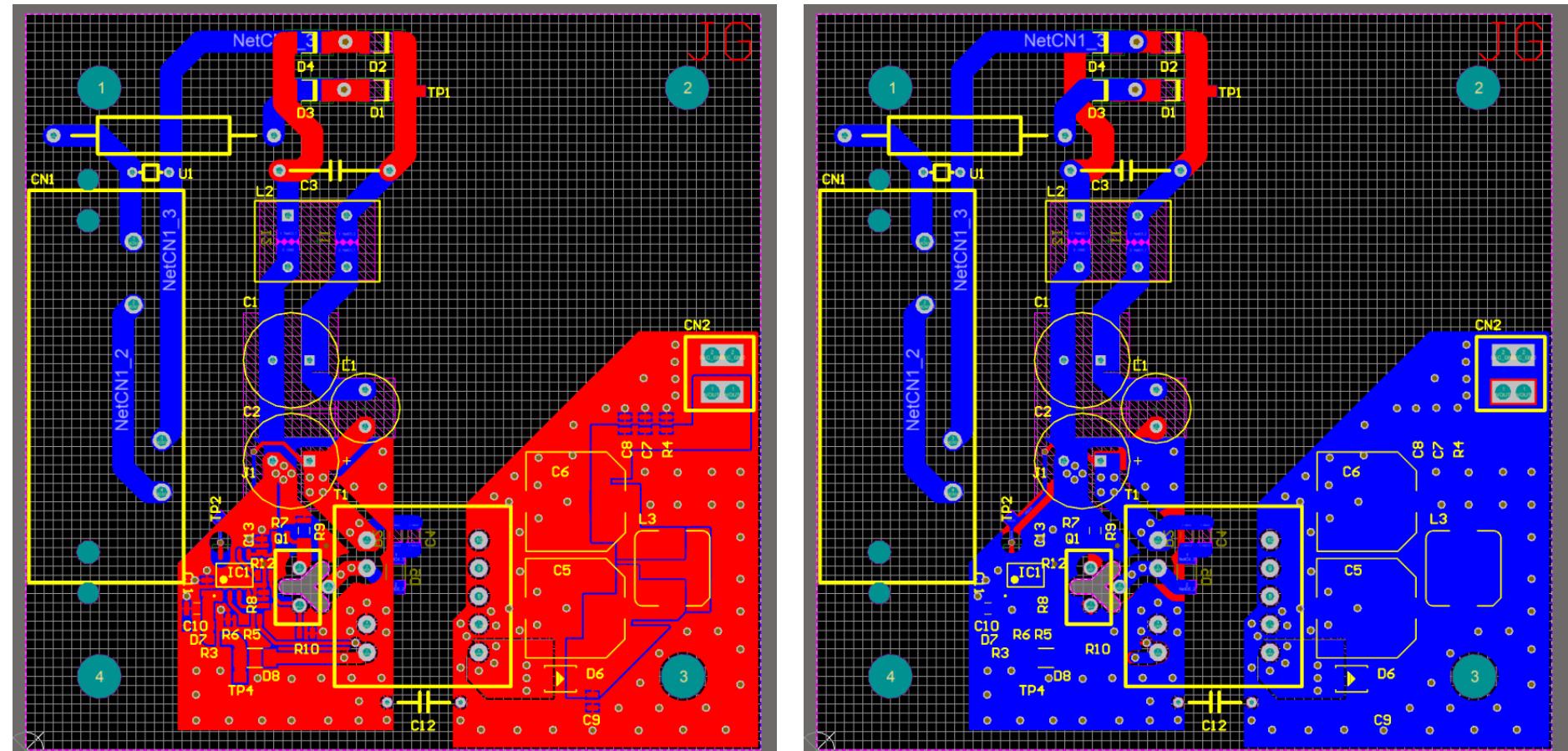


# Janez Govednik - shema

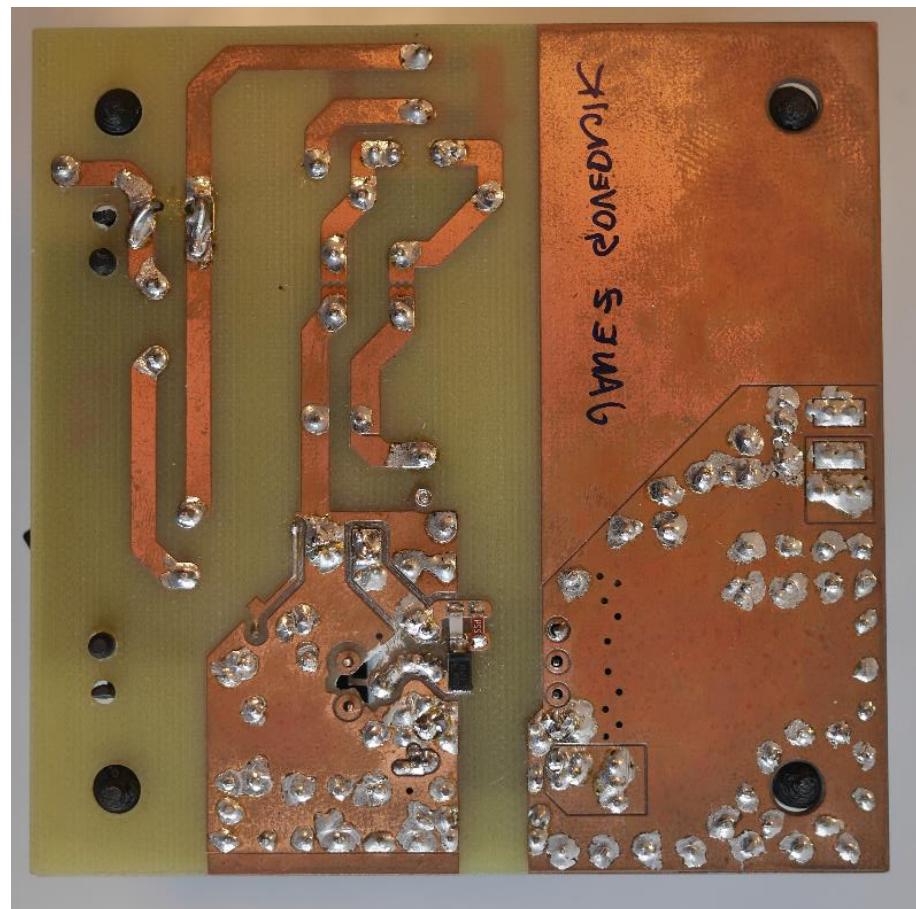
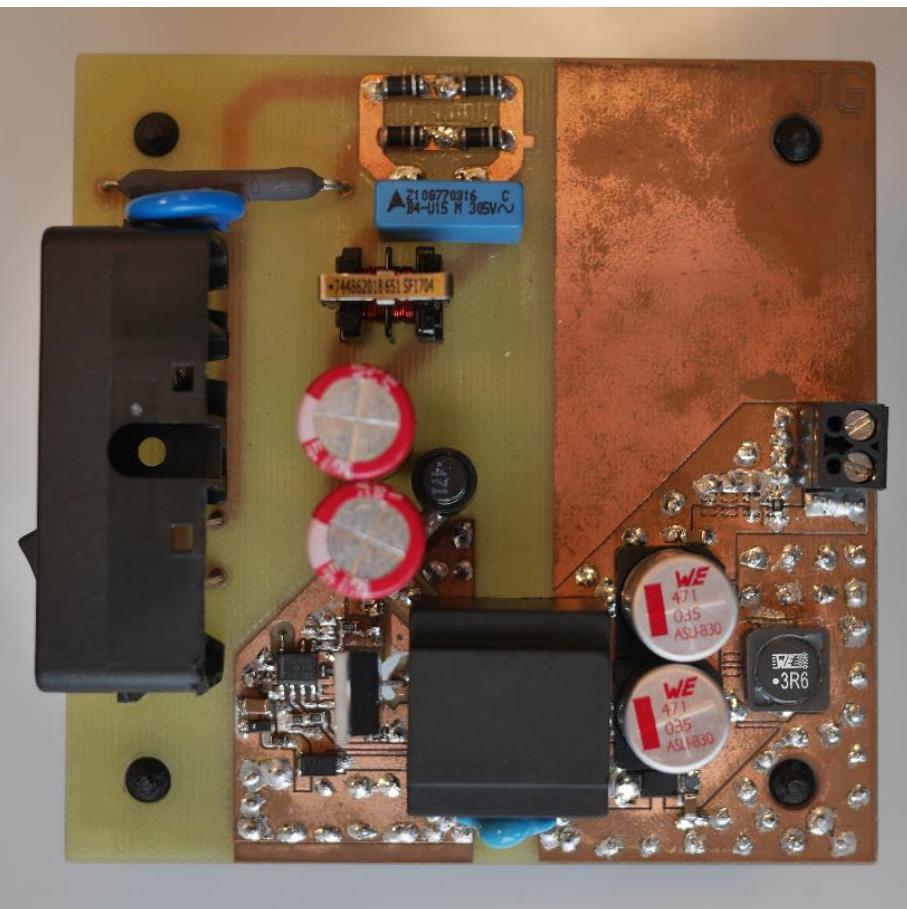


Uizh /0	Uizh 1W	Uizh 10W	ripple 1W	ripple 10W	HF šum
20.38 V	20.35 V	20.07 V	300 mV	25 mV	60 mV

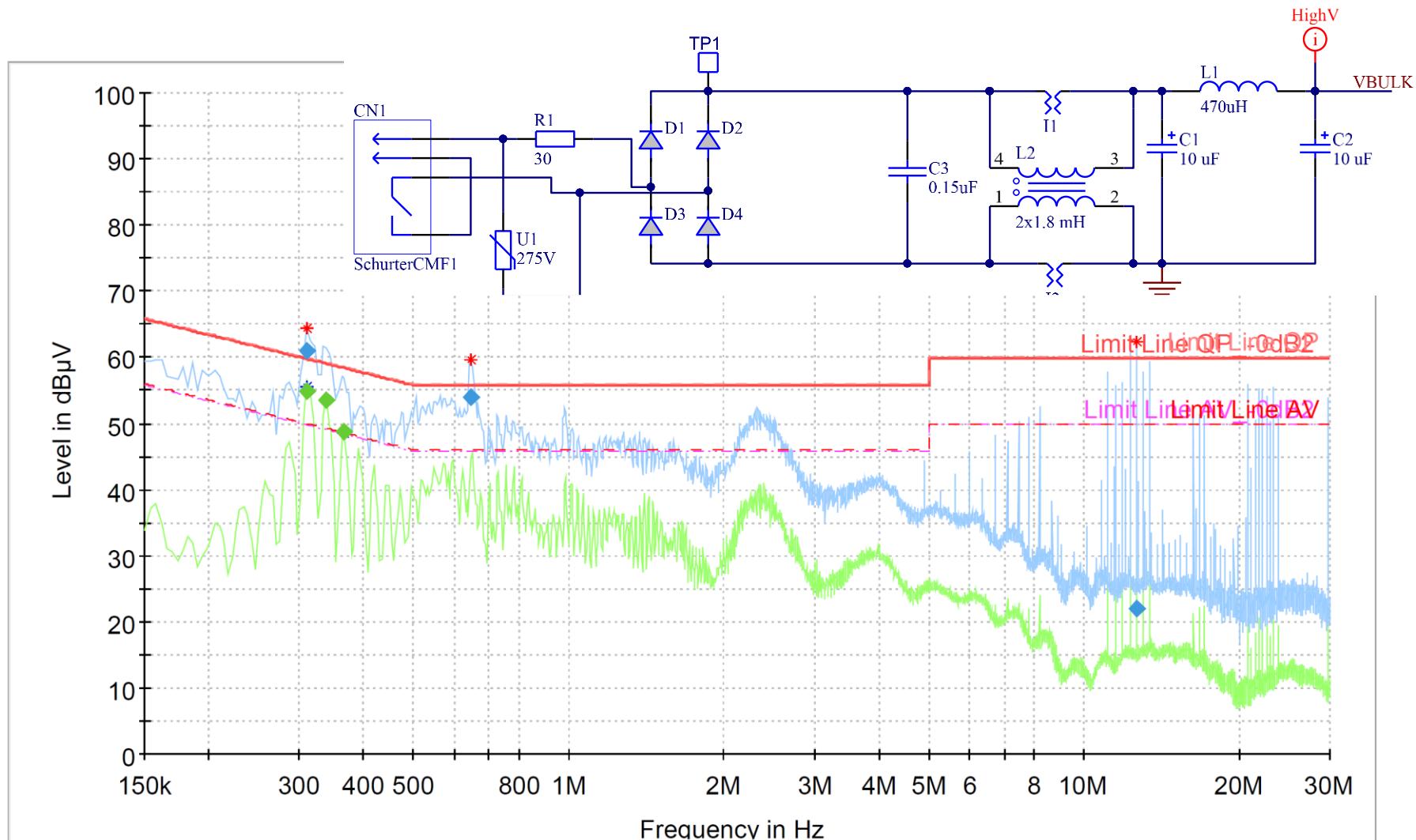
# Janez Govednik - načrt TIV



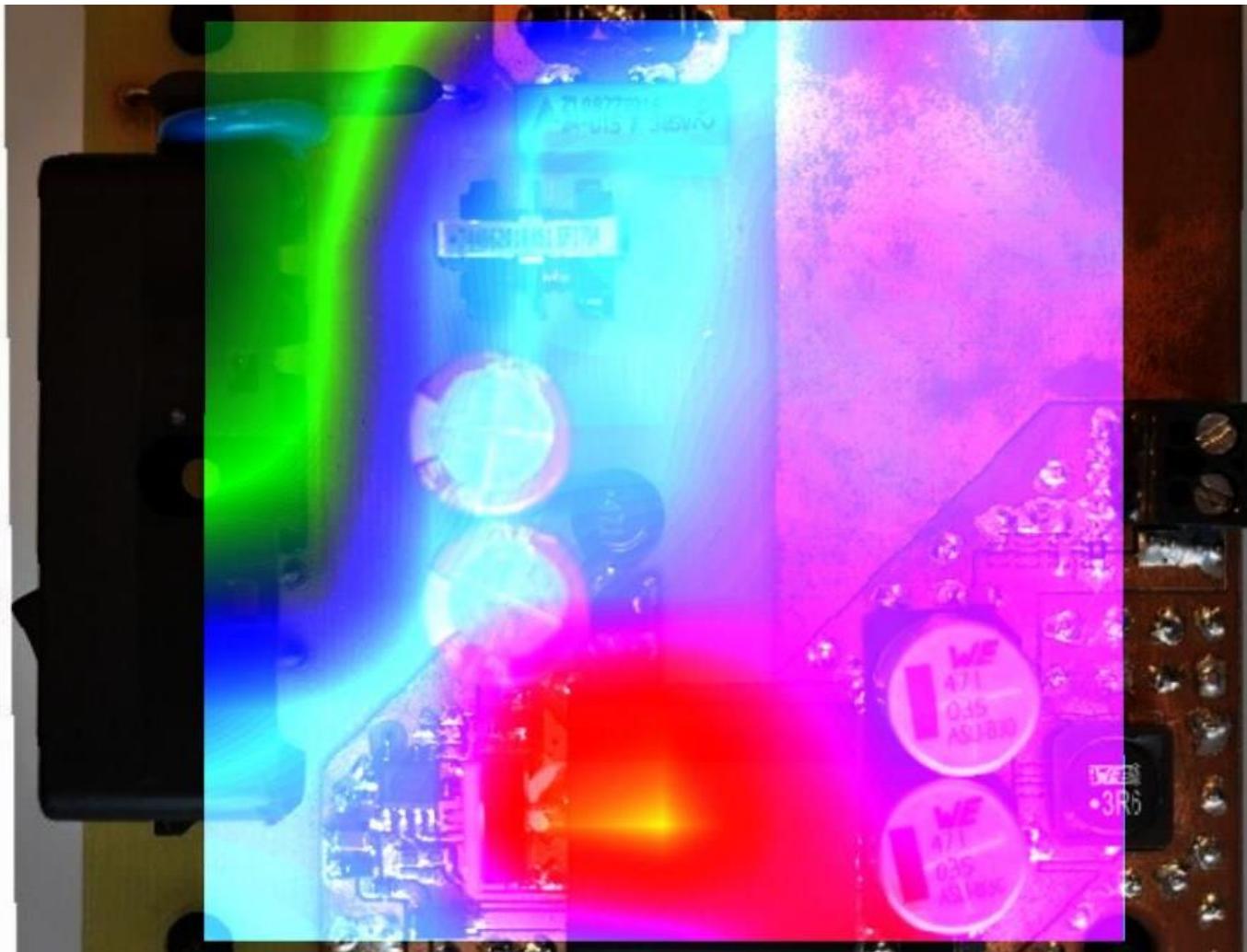
# Janez Govednik - izdelano TIV



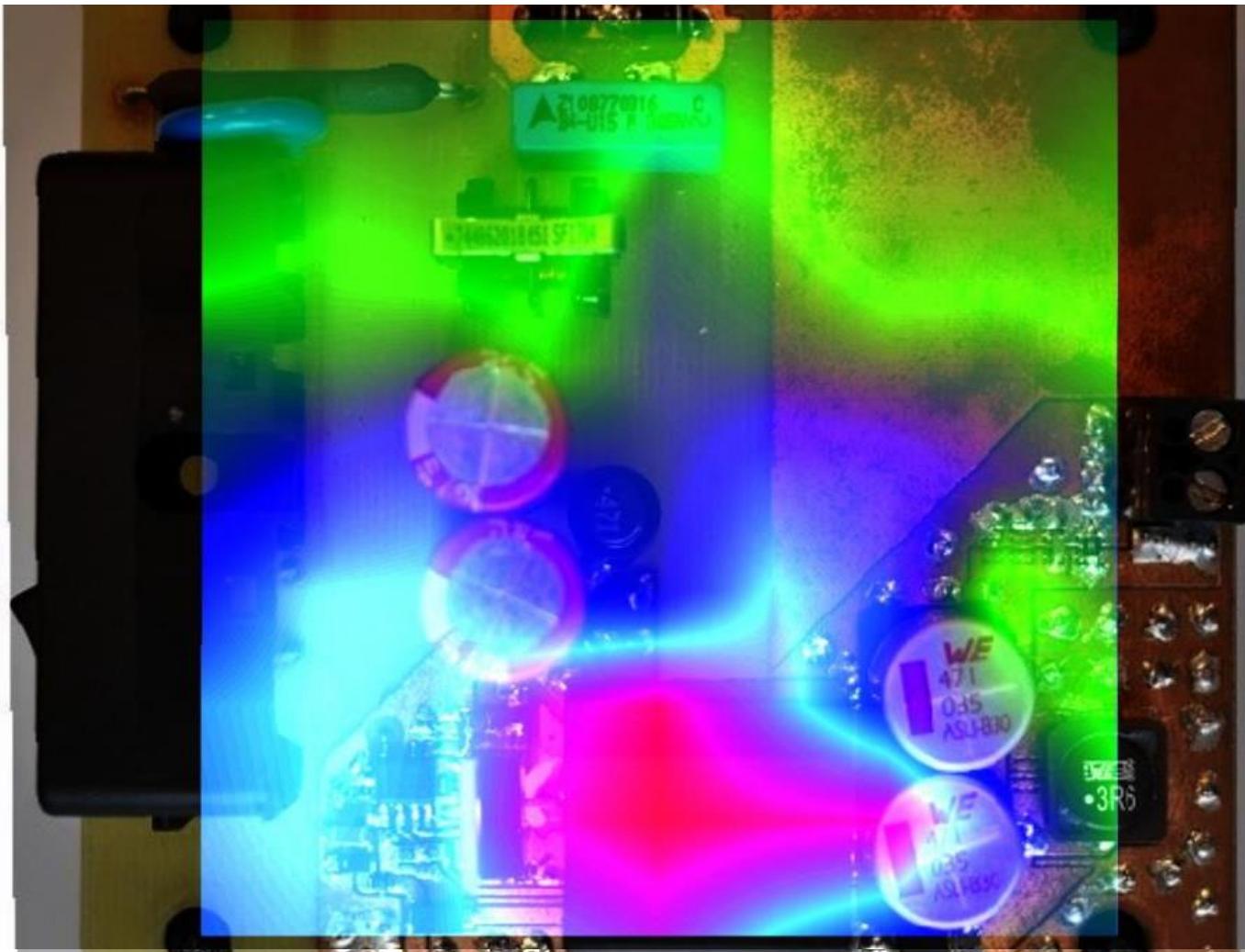
# Janez Govednik - CE



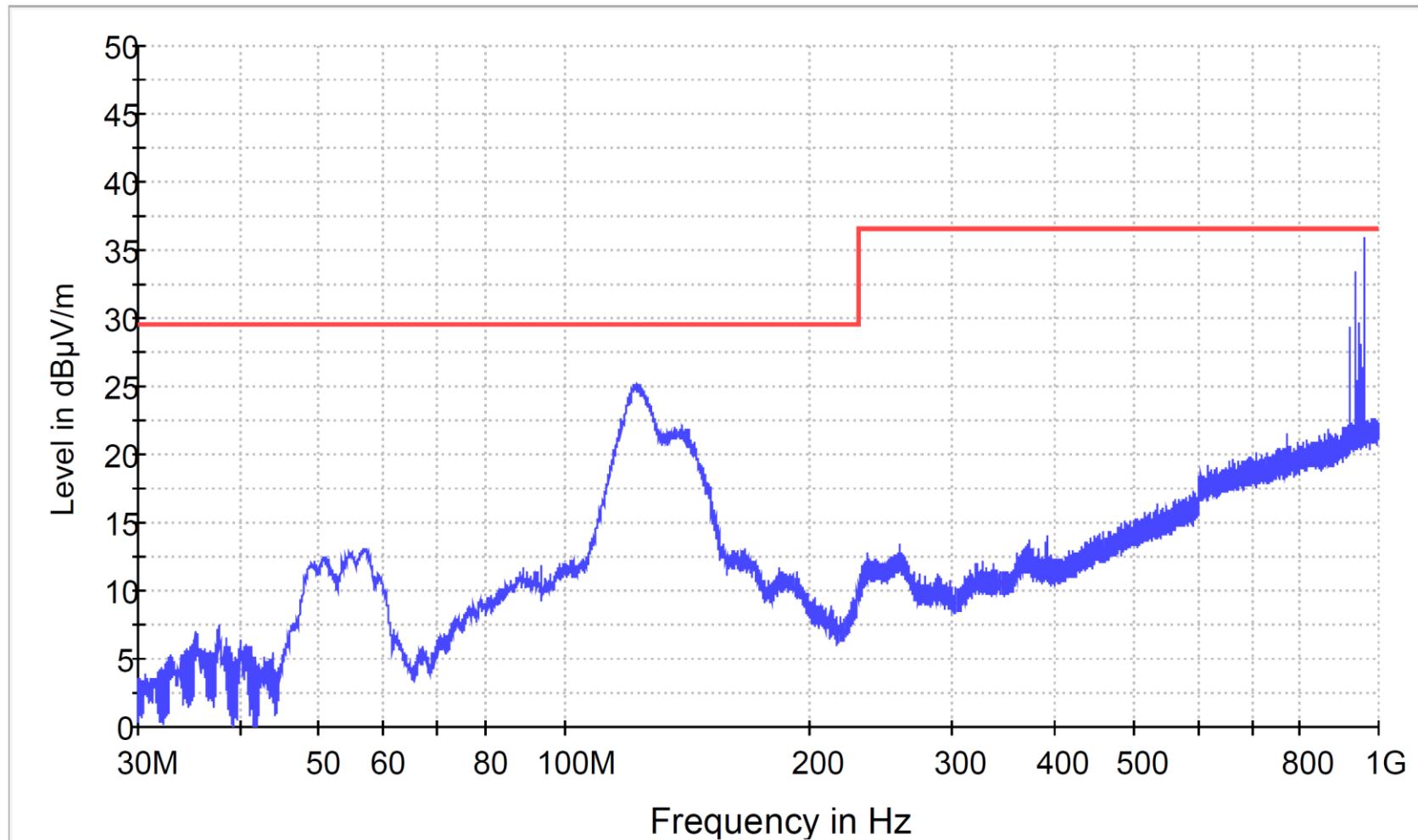
# Janez Govednik – E 306 kHz



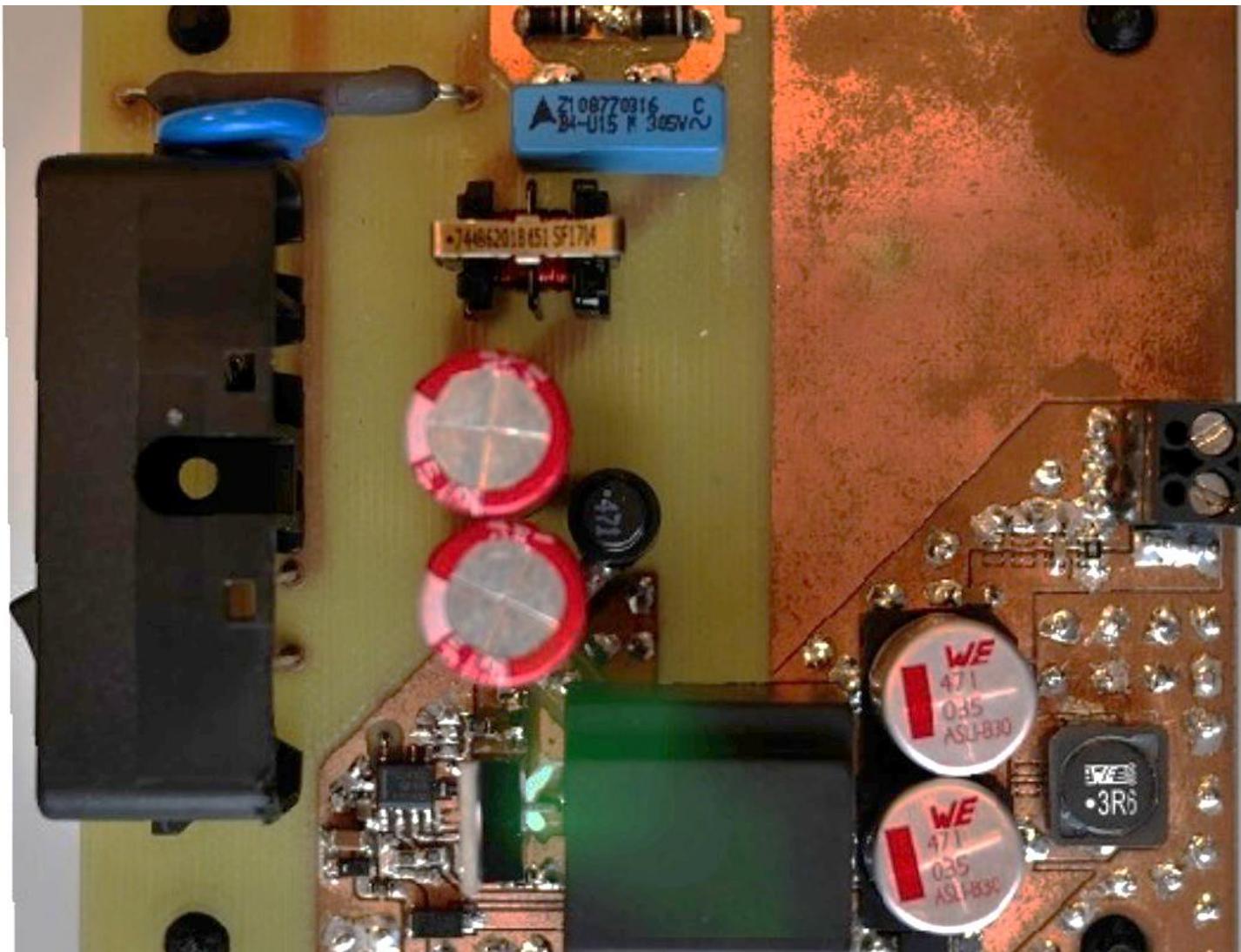
# Janez Govednik – H 306 kHz



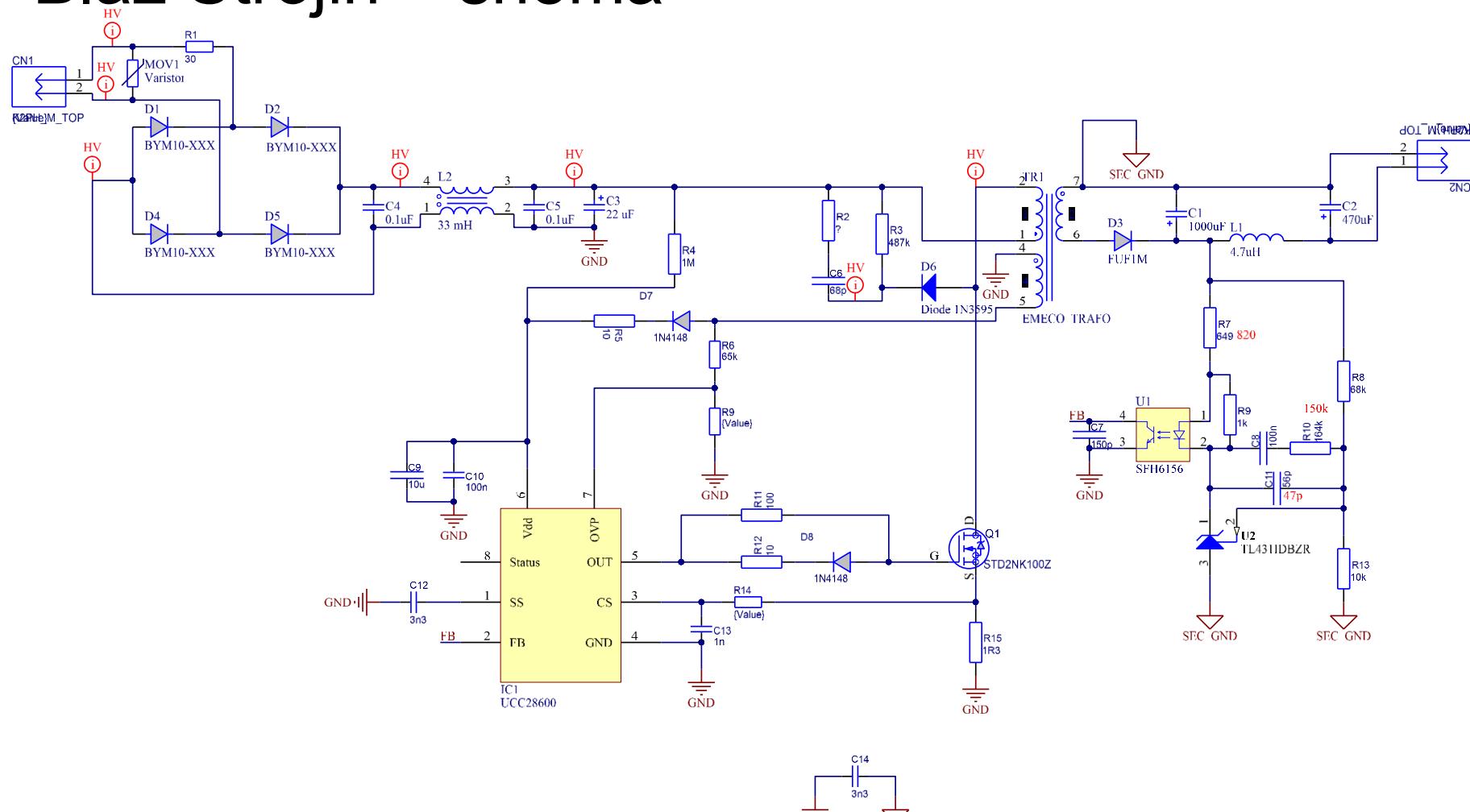
# Janez Govednik - RE



# Janez Govednik – H 120 MHz

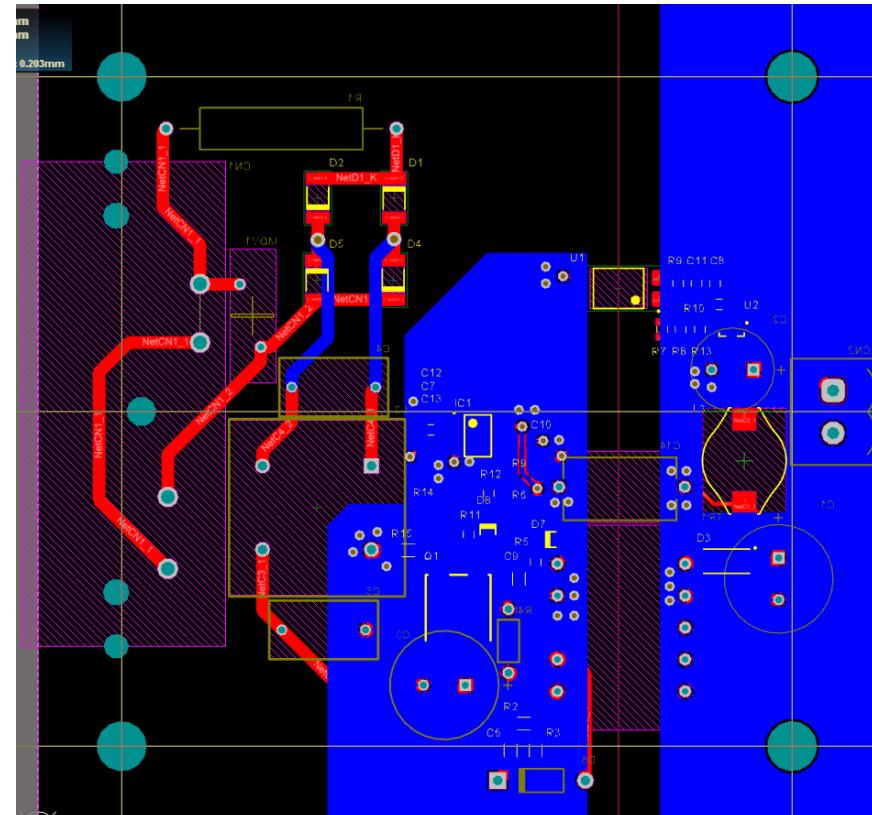
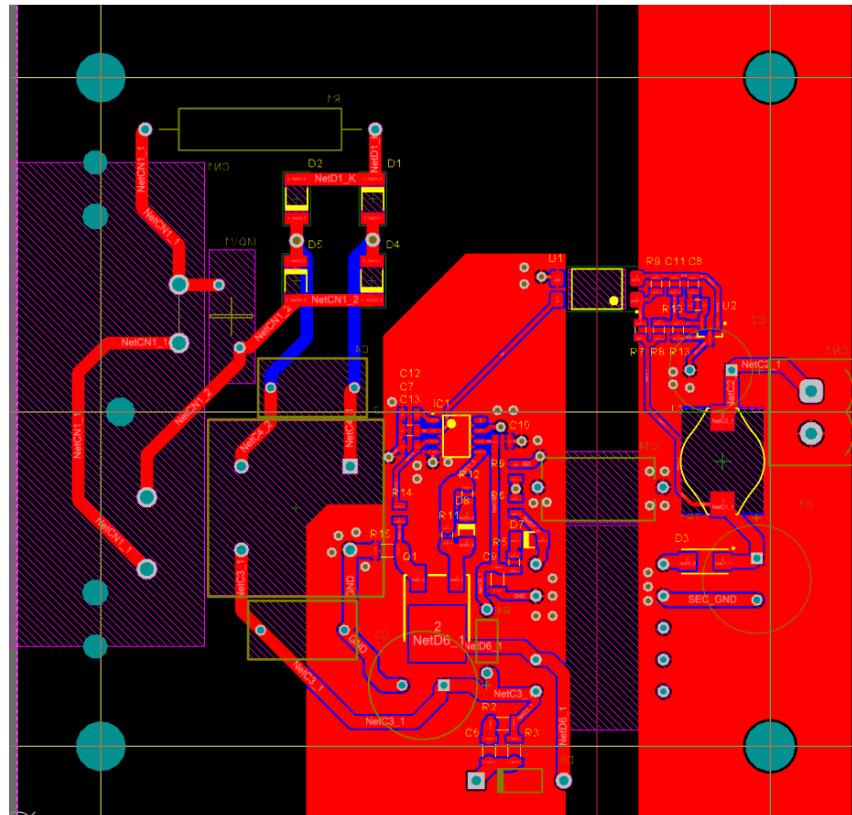


# Blaž Strojin – shema

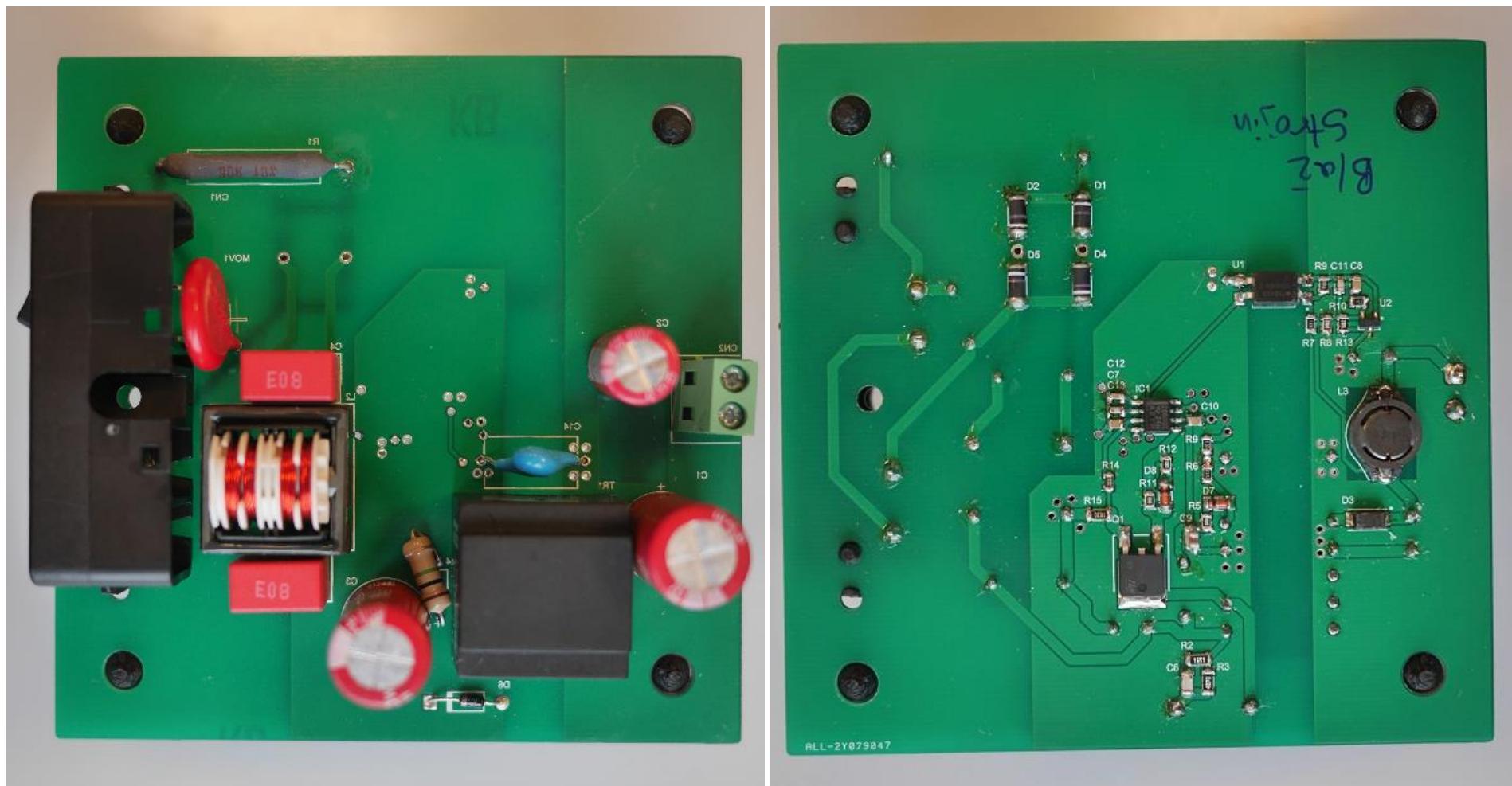


Uizh /0	Uizh 1W	Uizh 10W	ripple 1W	ripple 10W	HF šum
19.74 V	19.74 V	19.7 V	23 mV	5 mV	40 mV

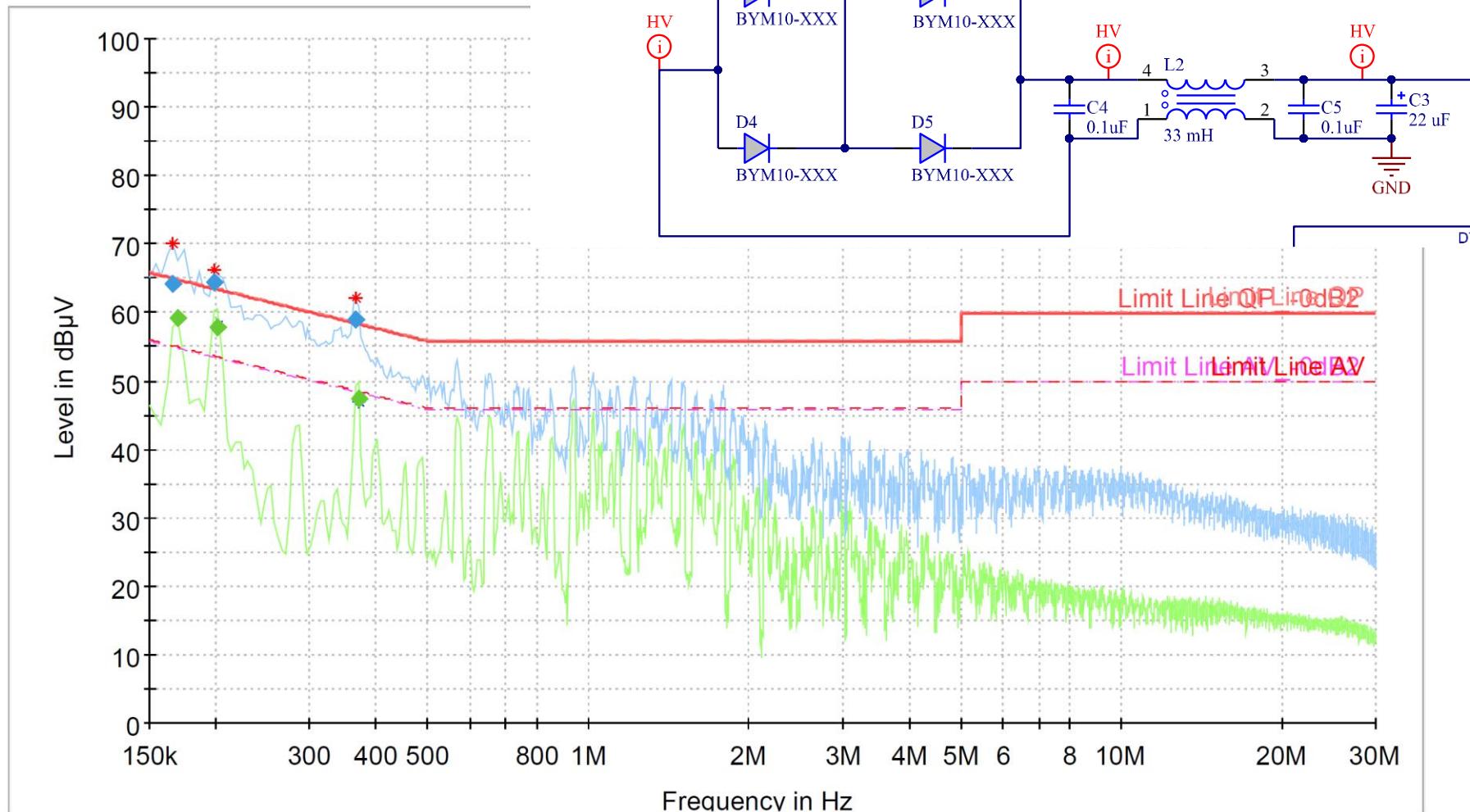
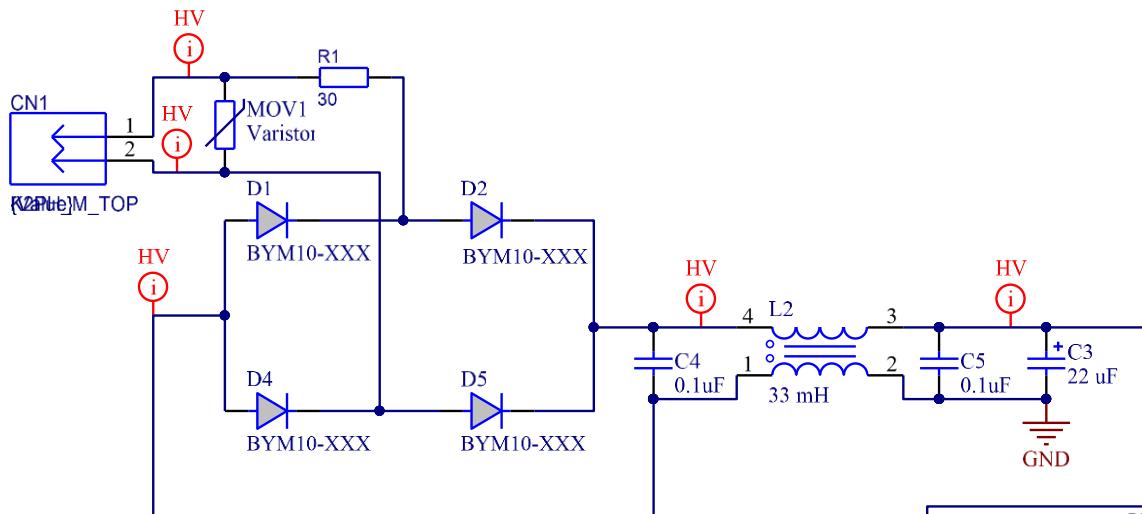
# Blaž Strojin – načrt TIV



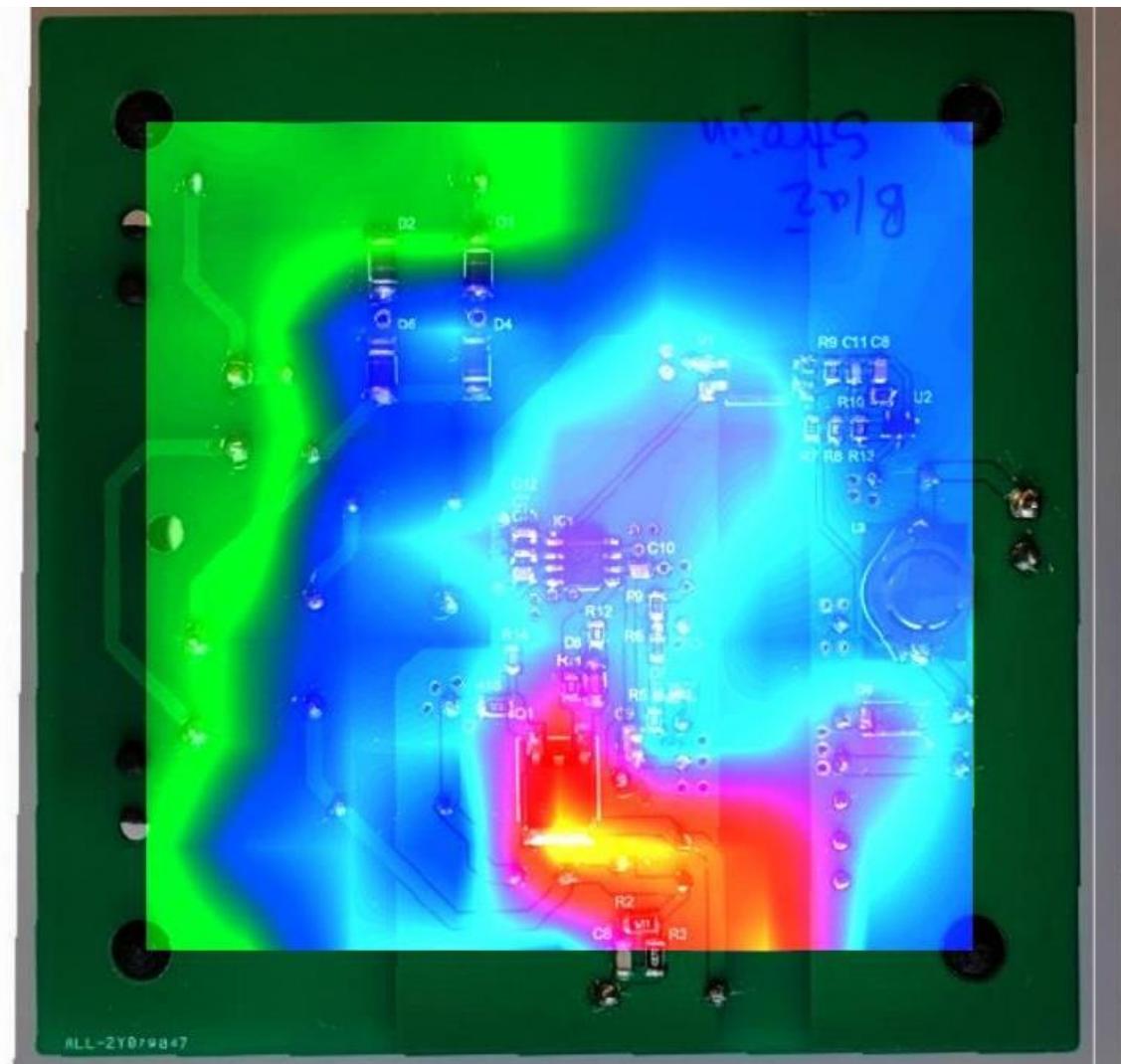
# Blaž Strojin – izdelano TIV



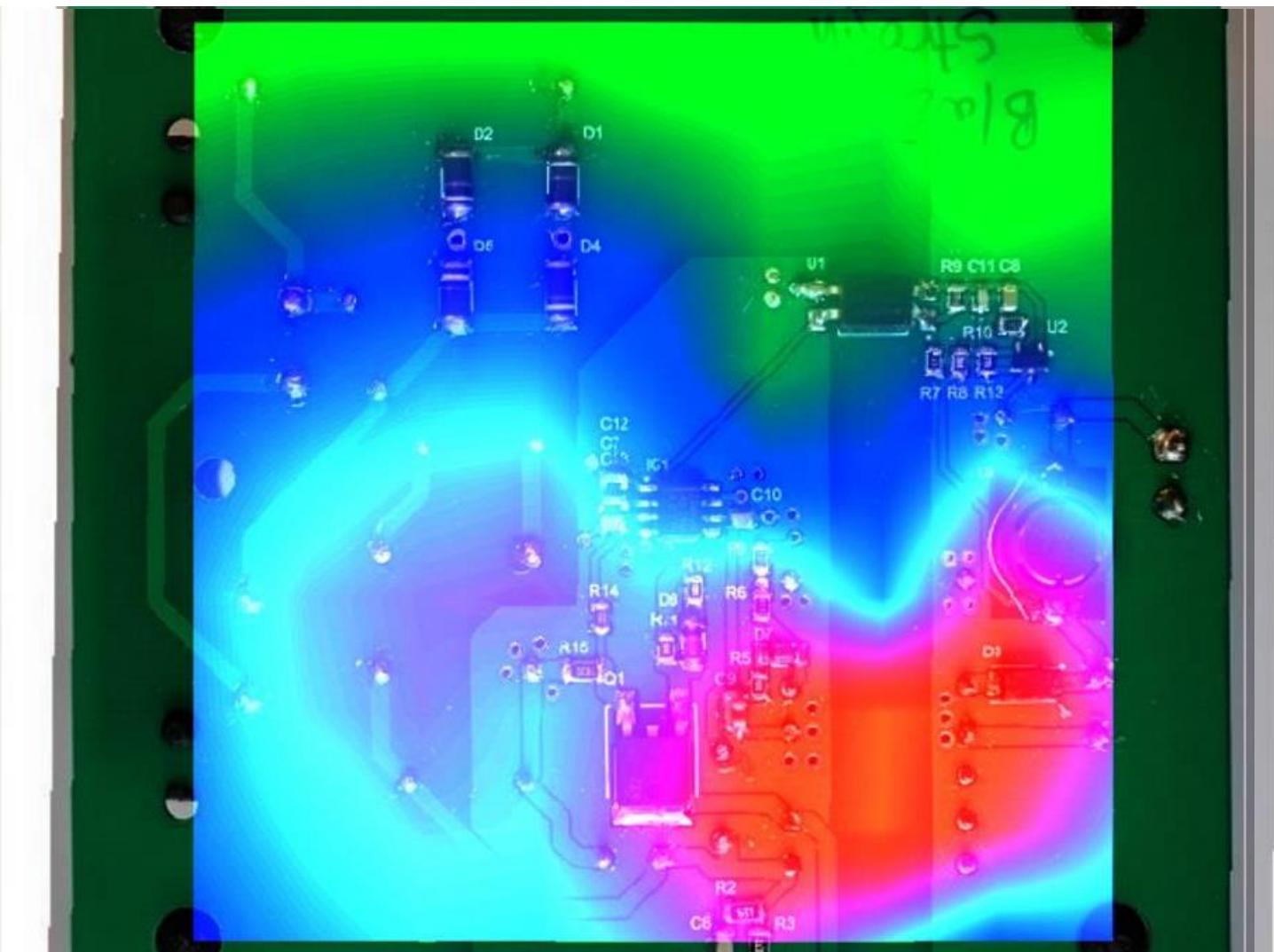
# Blaž Strojin - CE



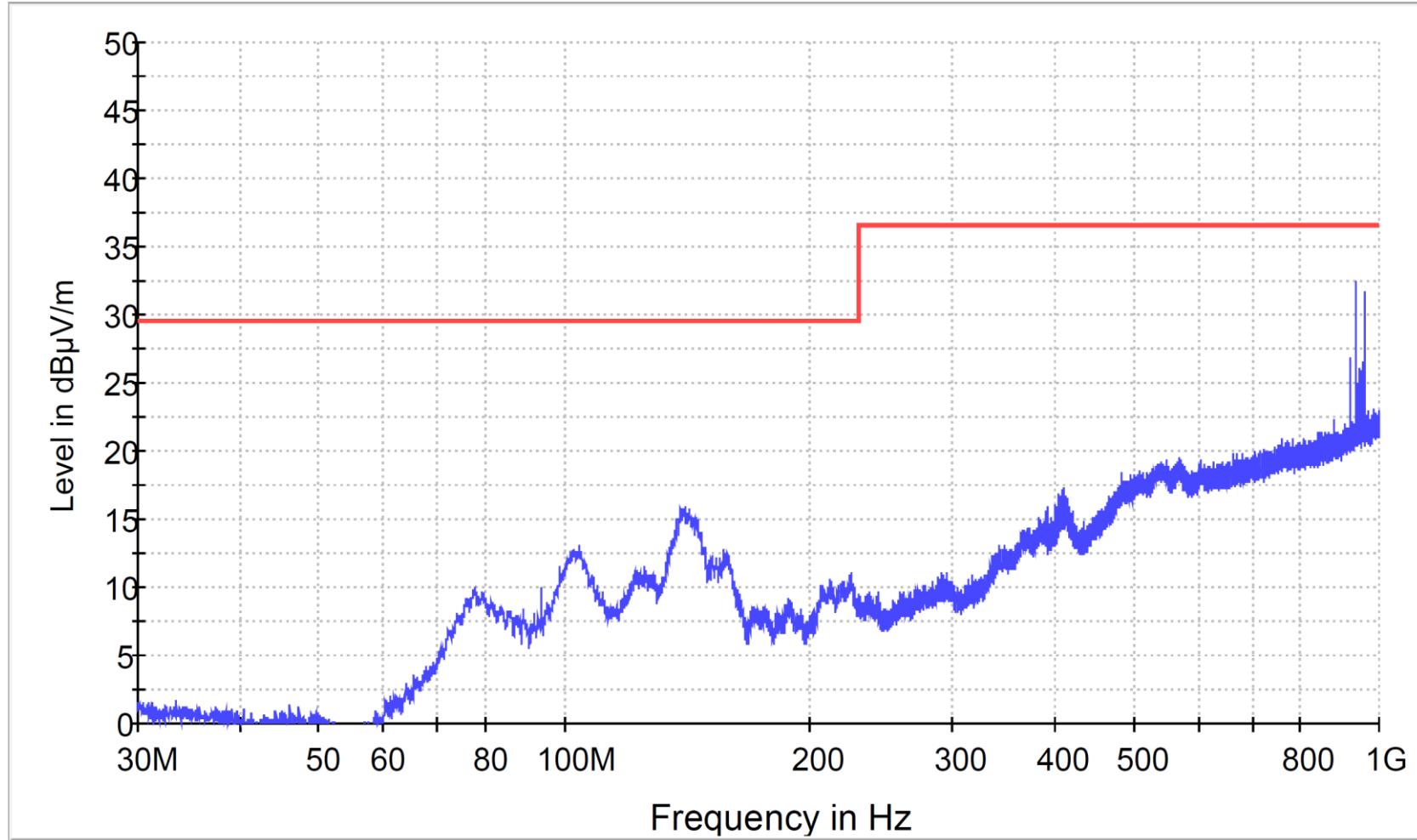
# Blaž Strojin – E 179 kHz



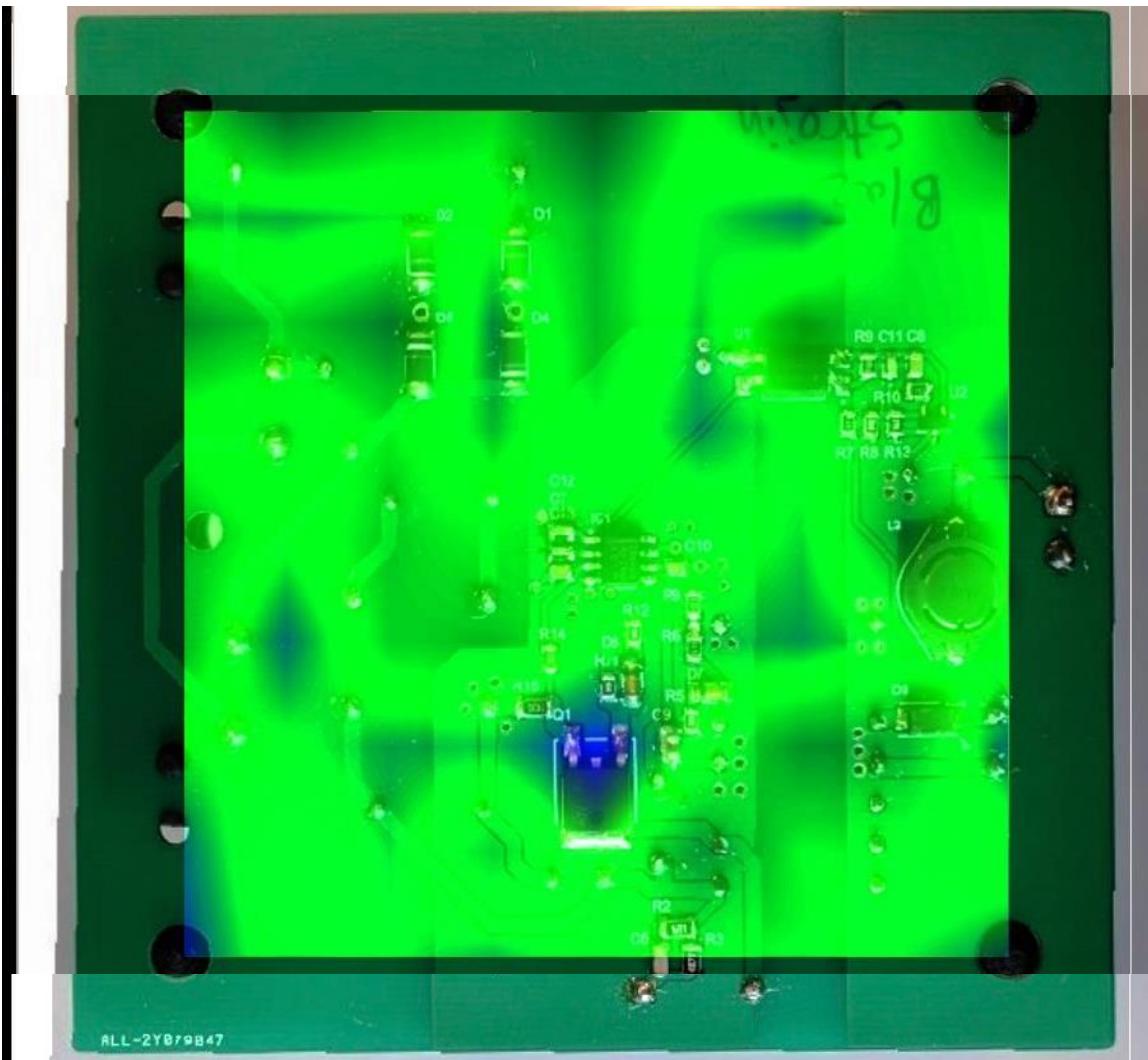
# Blaž Strojin – H 179 kHz



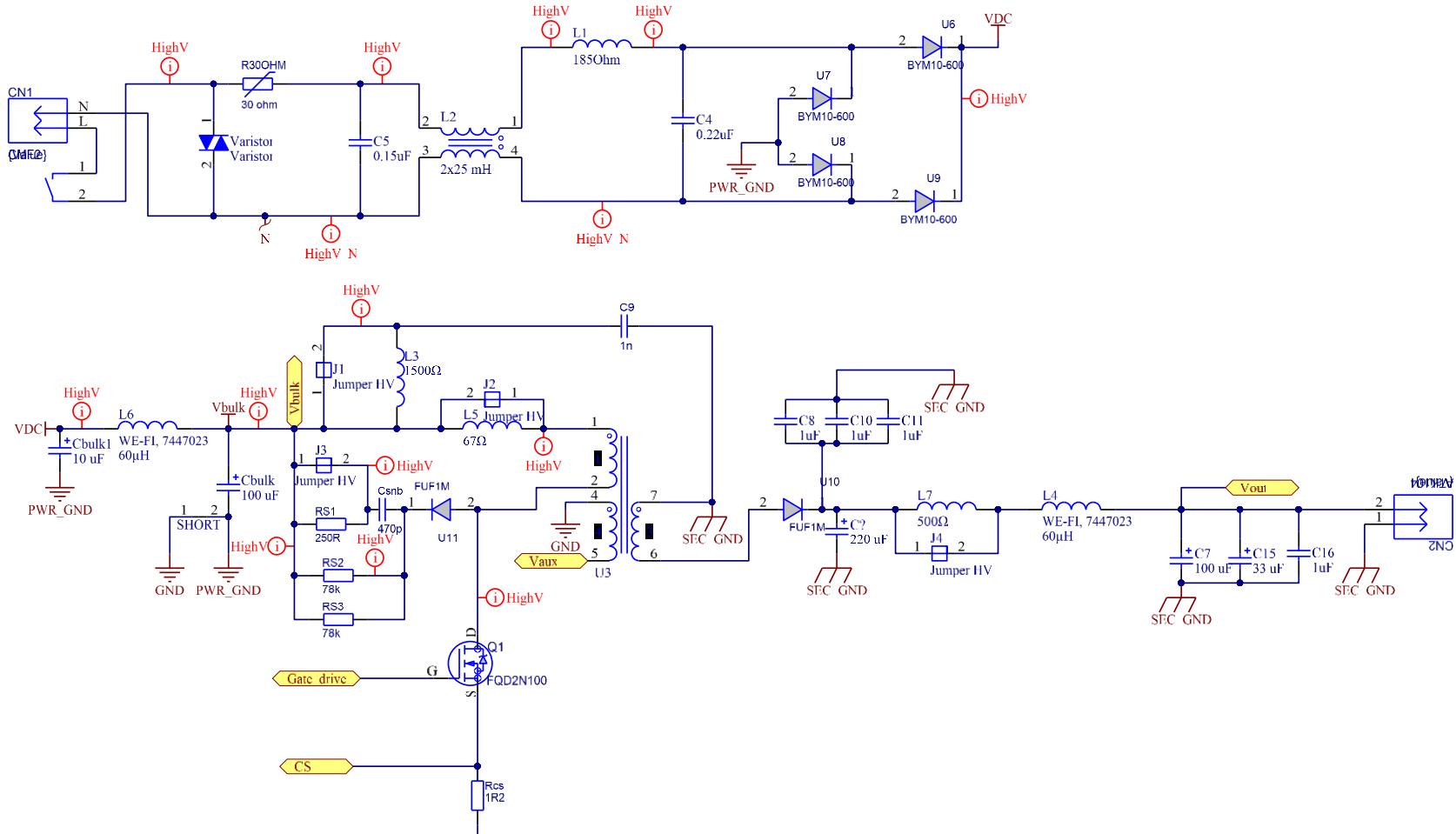
# Blaž Strojin – RE



# Blaž Strojin – H 120MHz

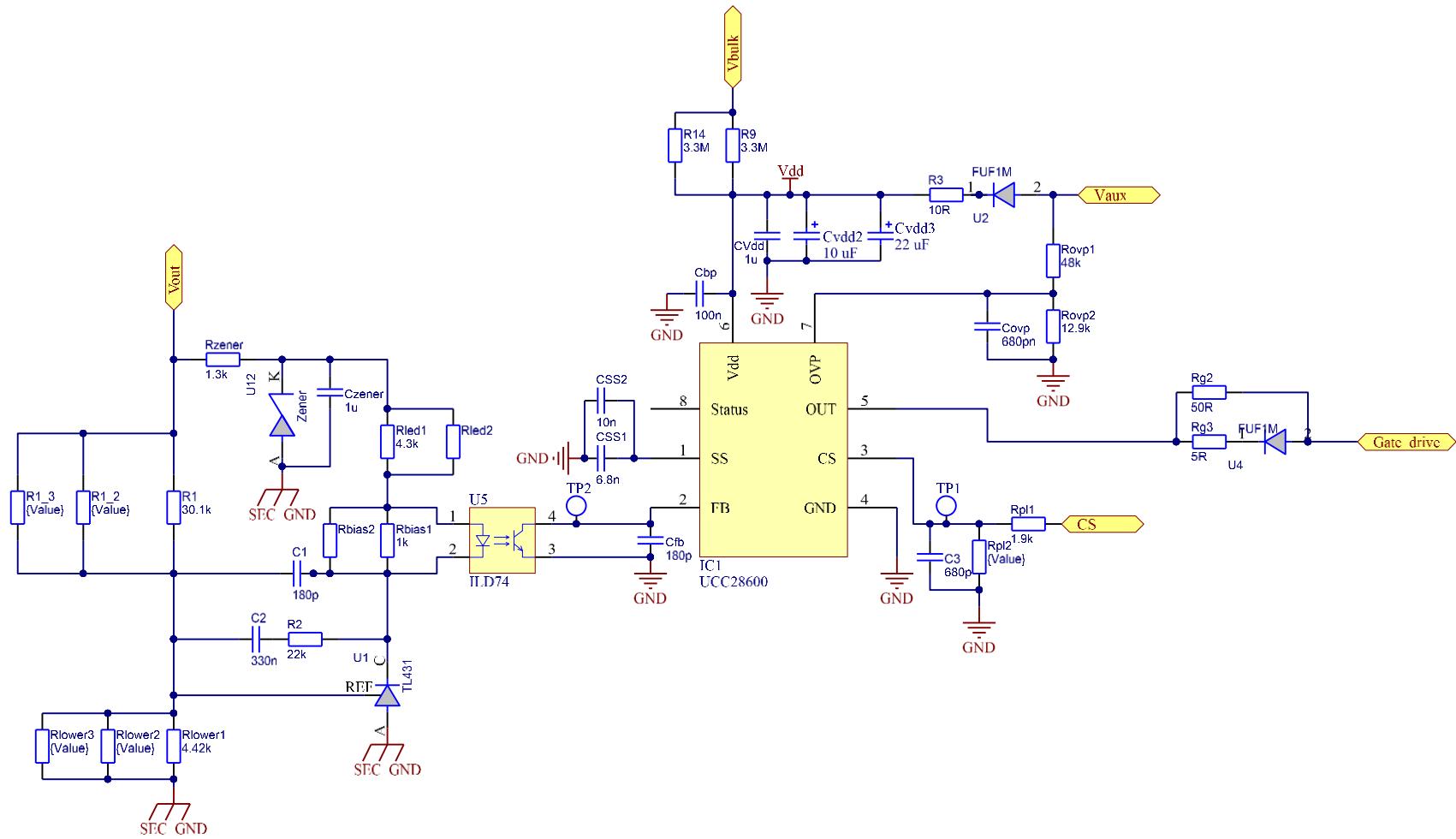


# Žiga Korošak - shema

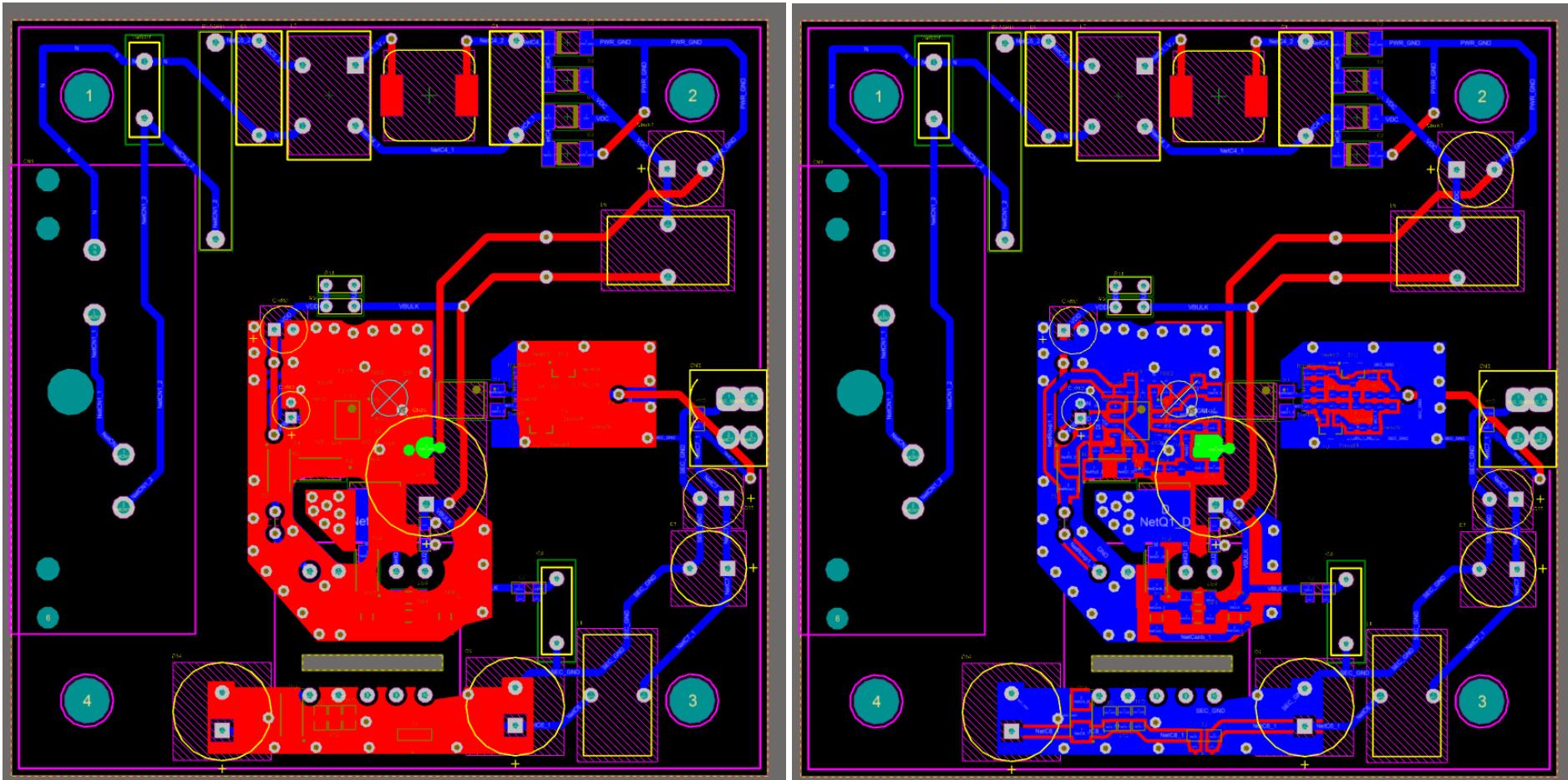


Uizh /0	Uizh 1W	Uizh 10W	ripple 1W	ripple 10W	HF šum
19.93 V	19.93 V	19.91 V	350 mV	20 mV	400 mV

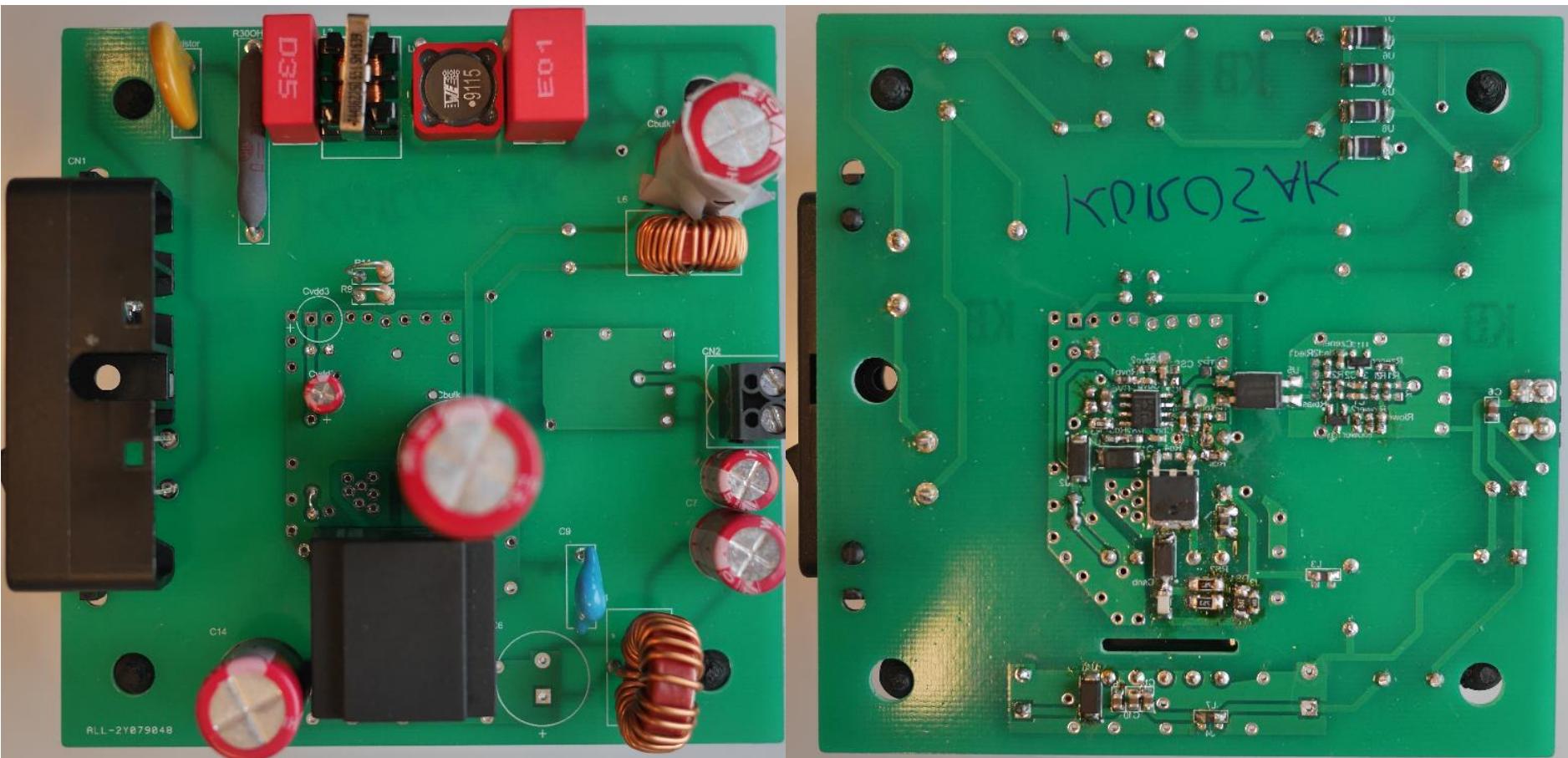
# Žiga Korošak - shema



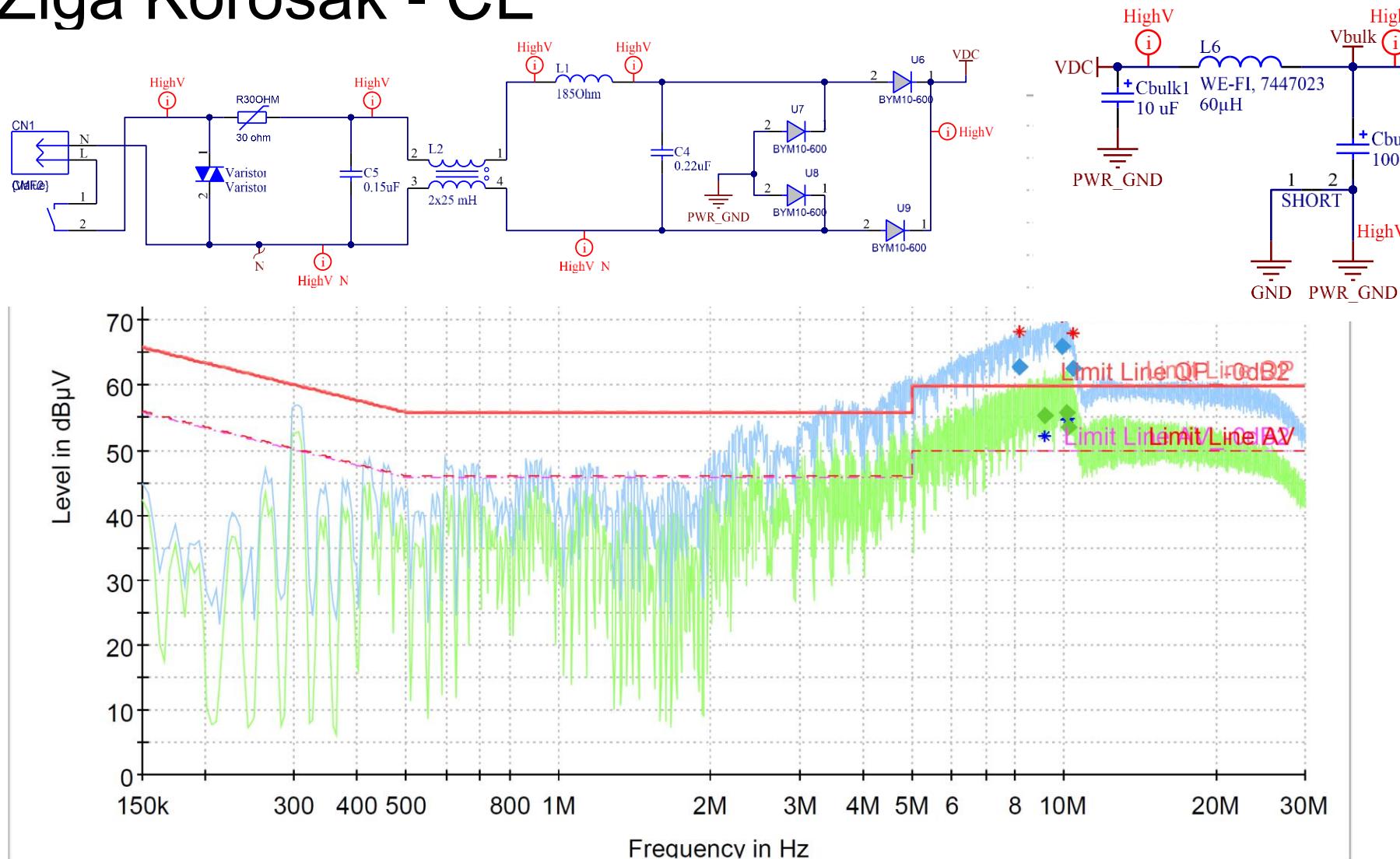
# Žiga Korošak – načrt TIV



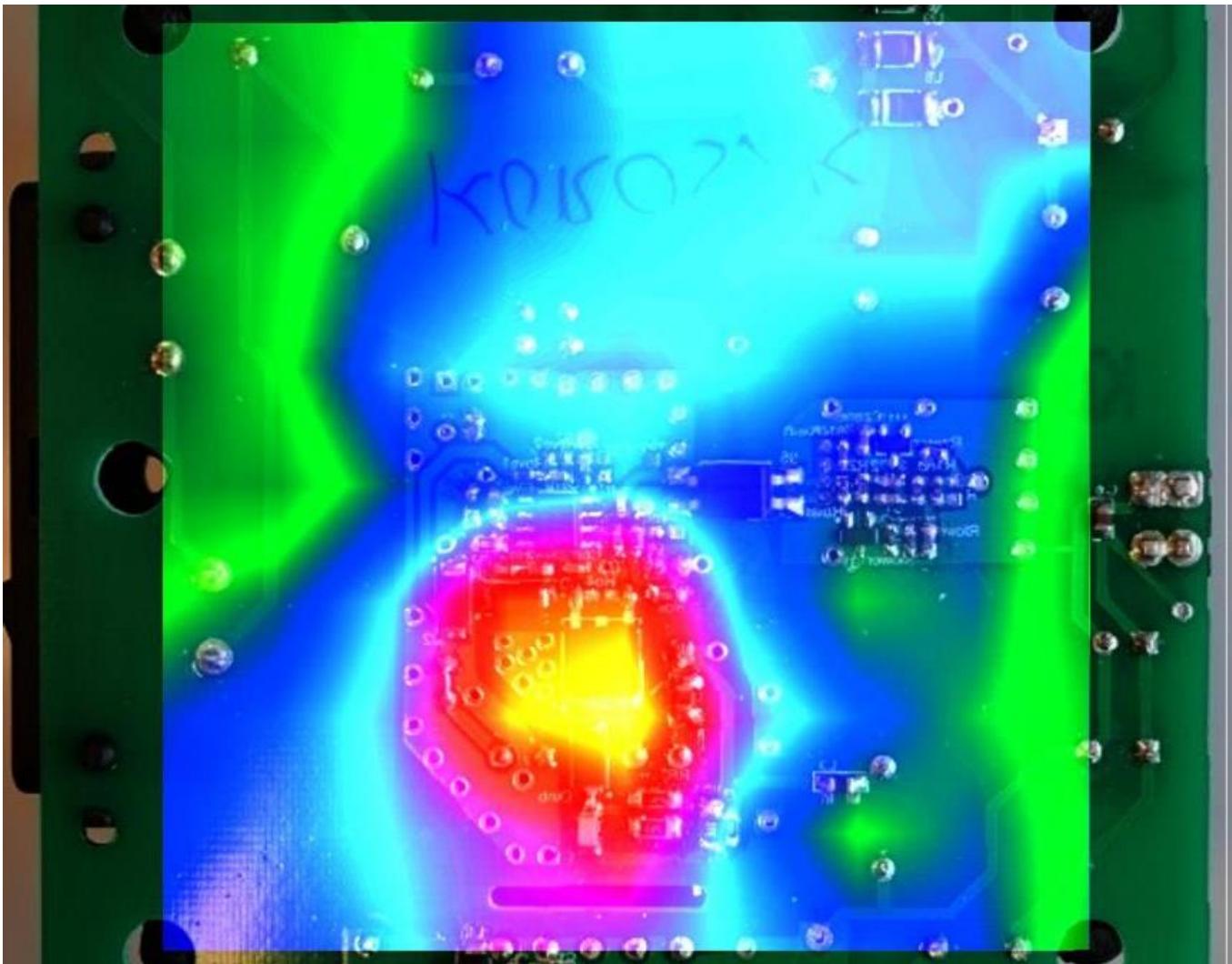
# Žiga Korošak - izdelano TIV



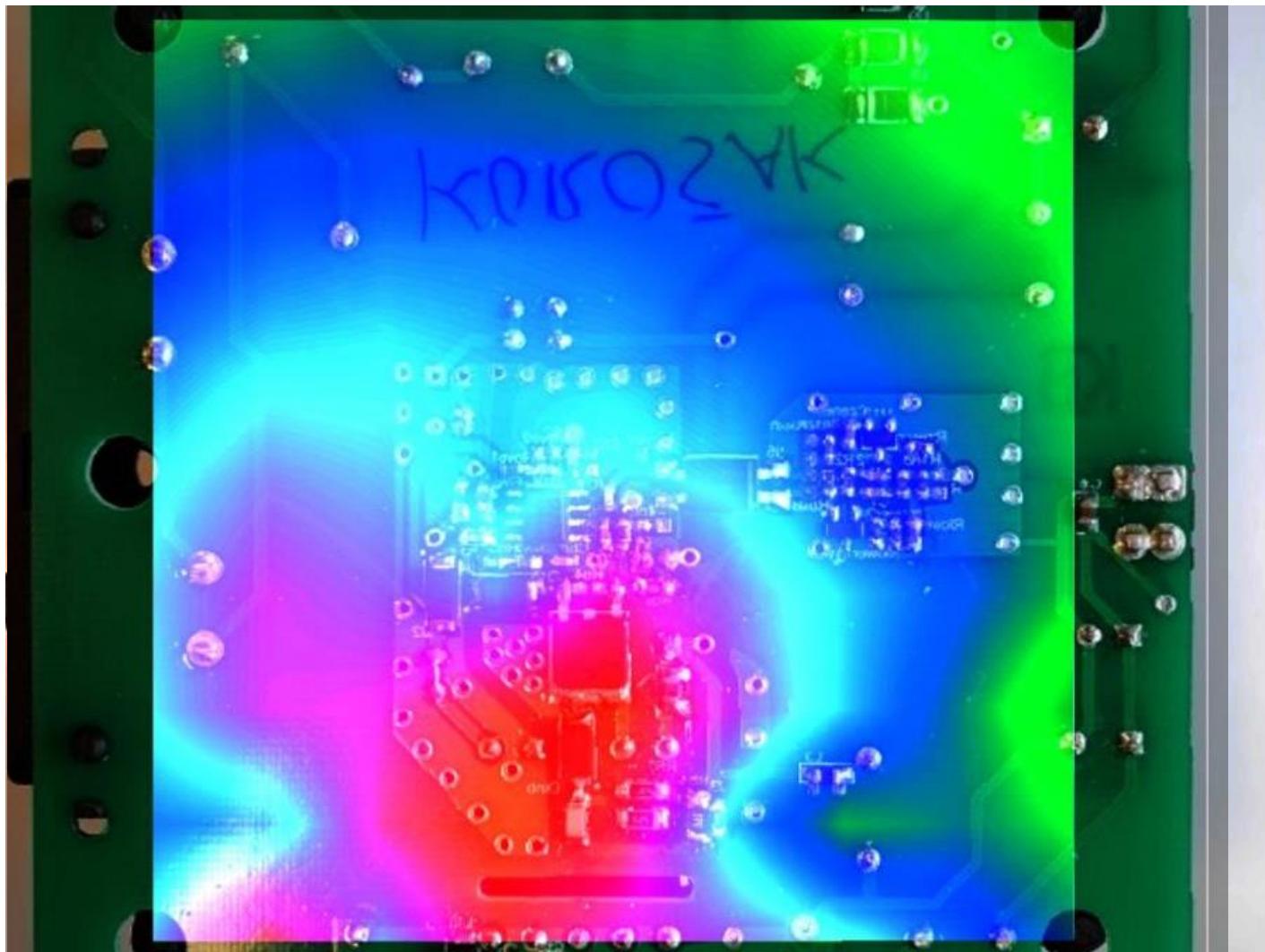
# Žiga Korošak - CE



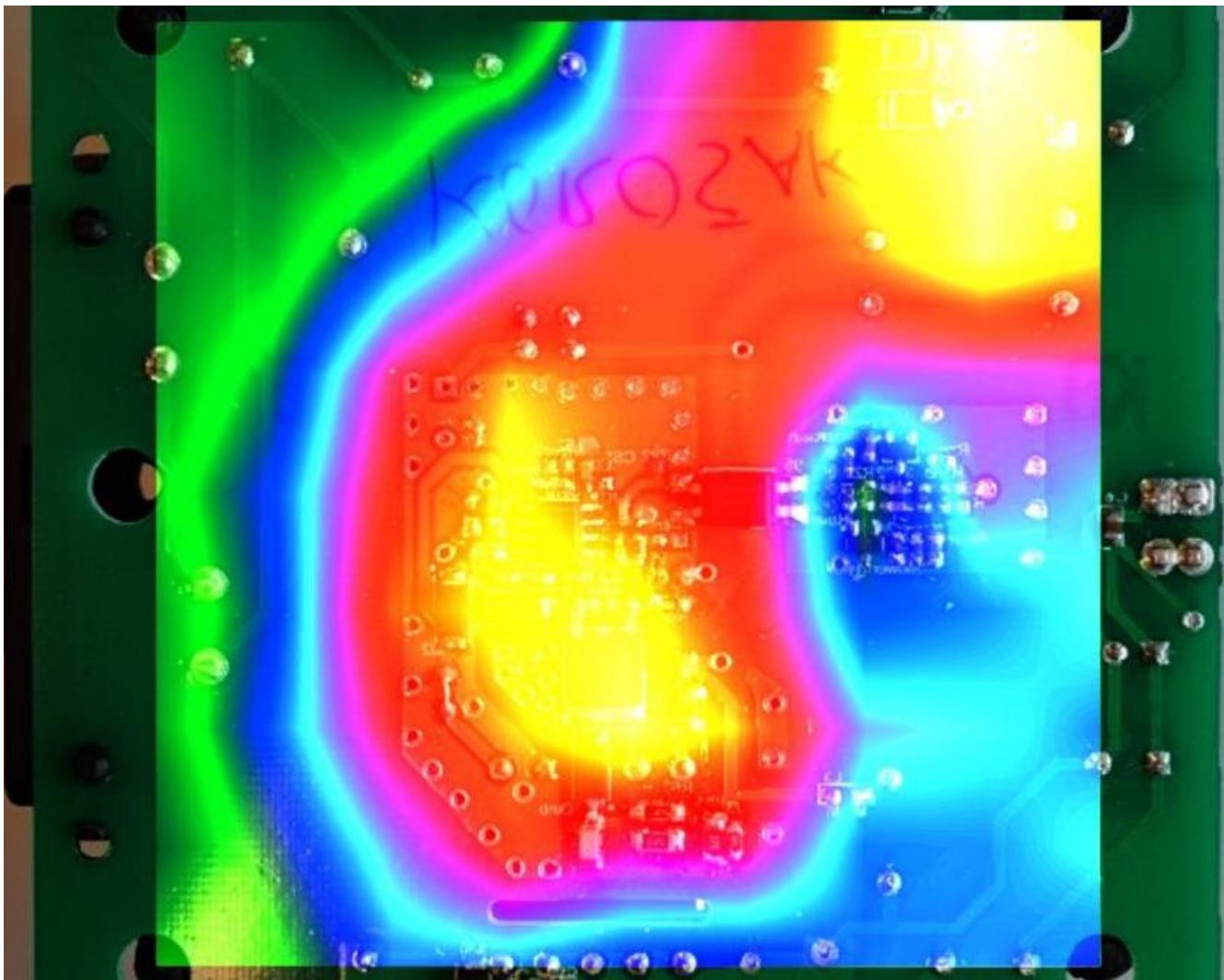
# Žiga Korošak – E 298 kHz



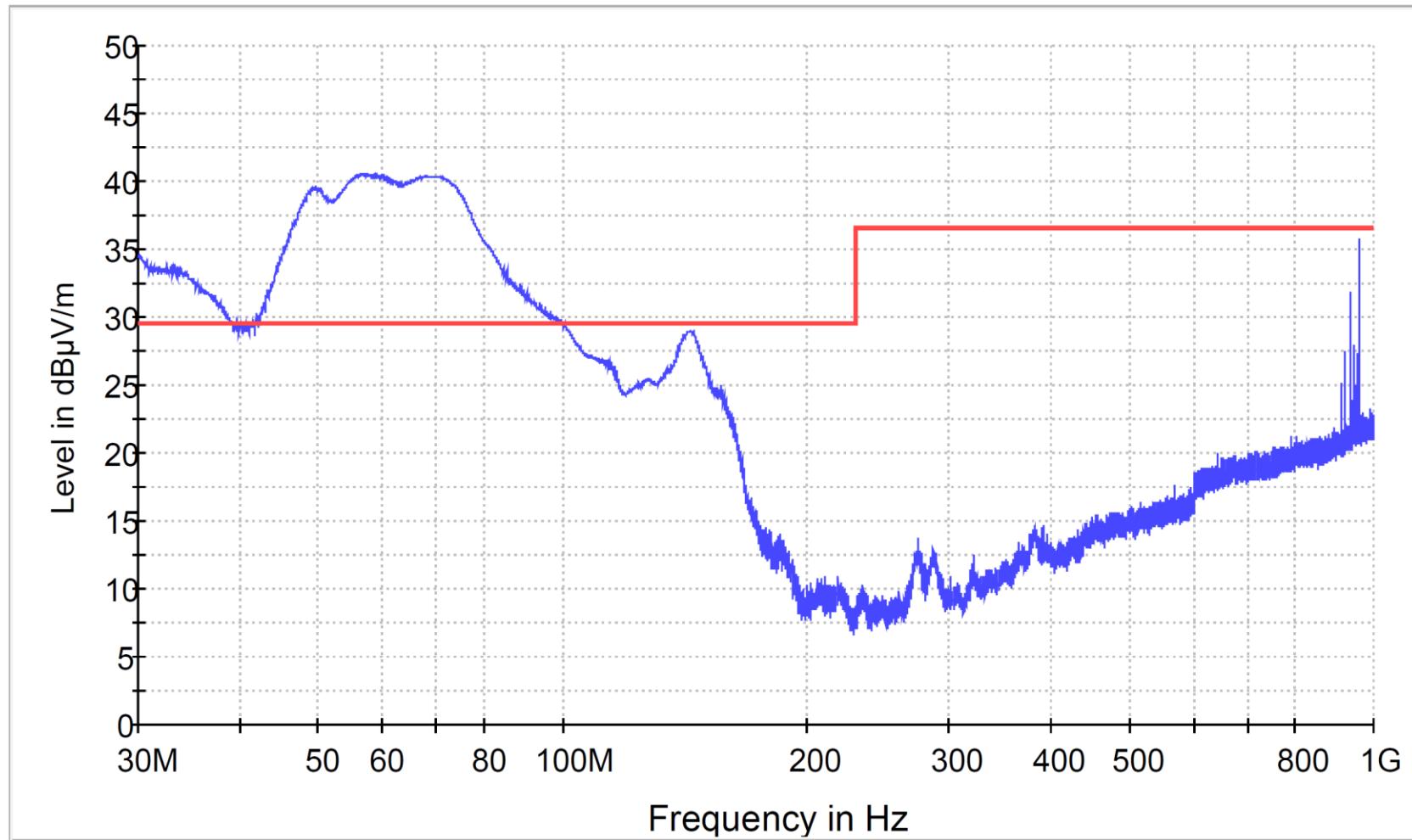
# Žiga Korošak – H 298 kHz



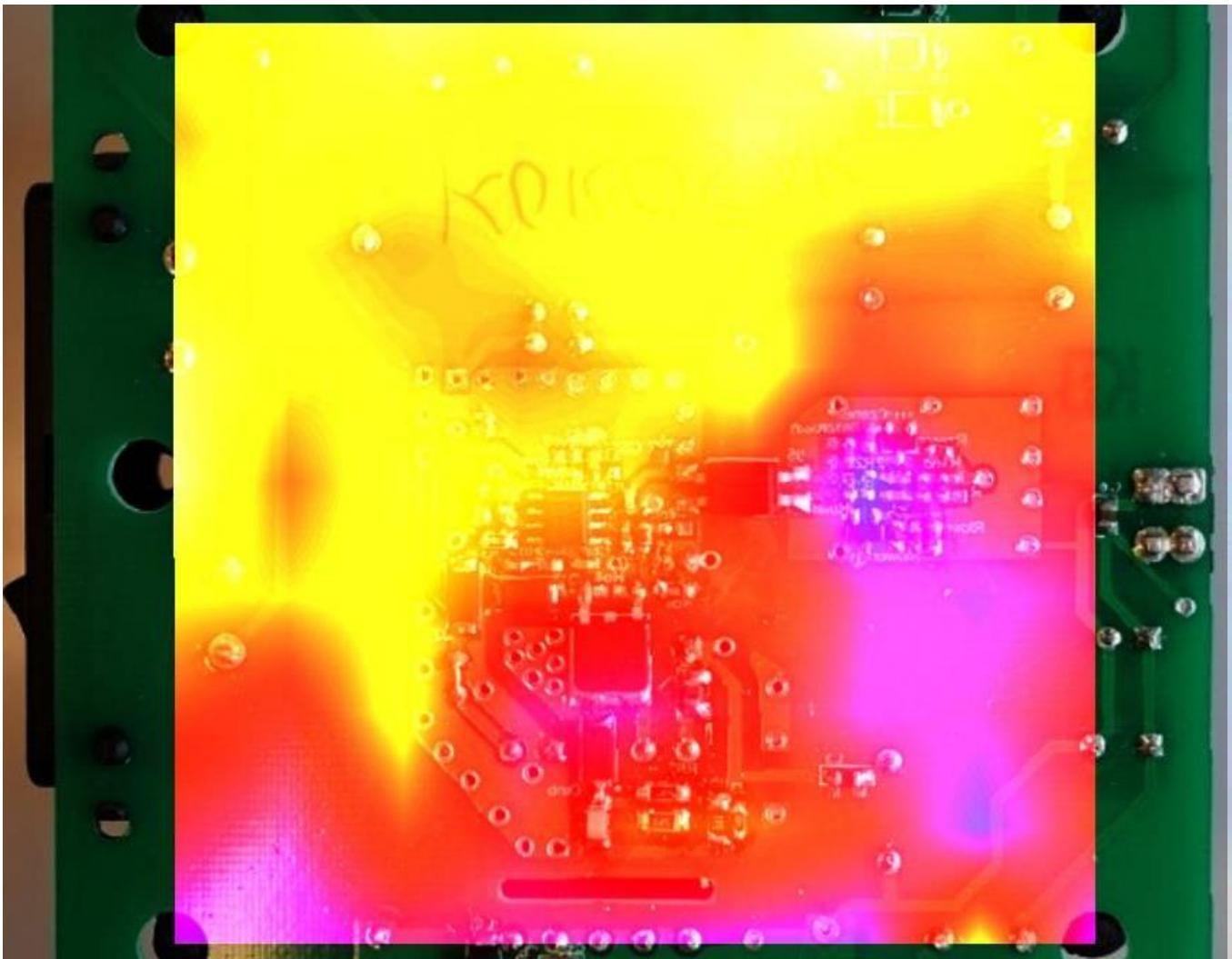
# Žiga Korošak – E 10 MHz



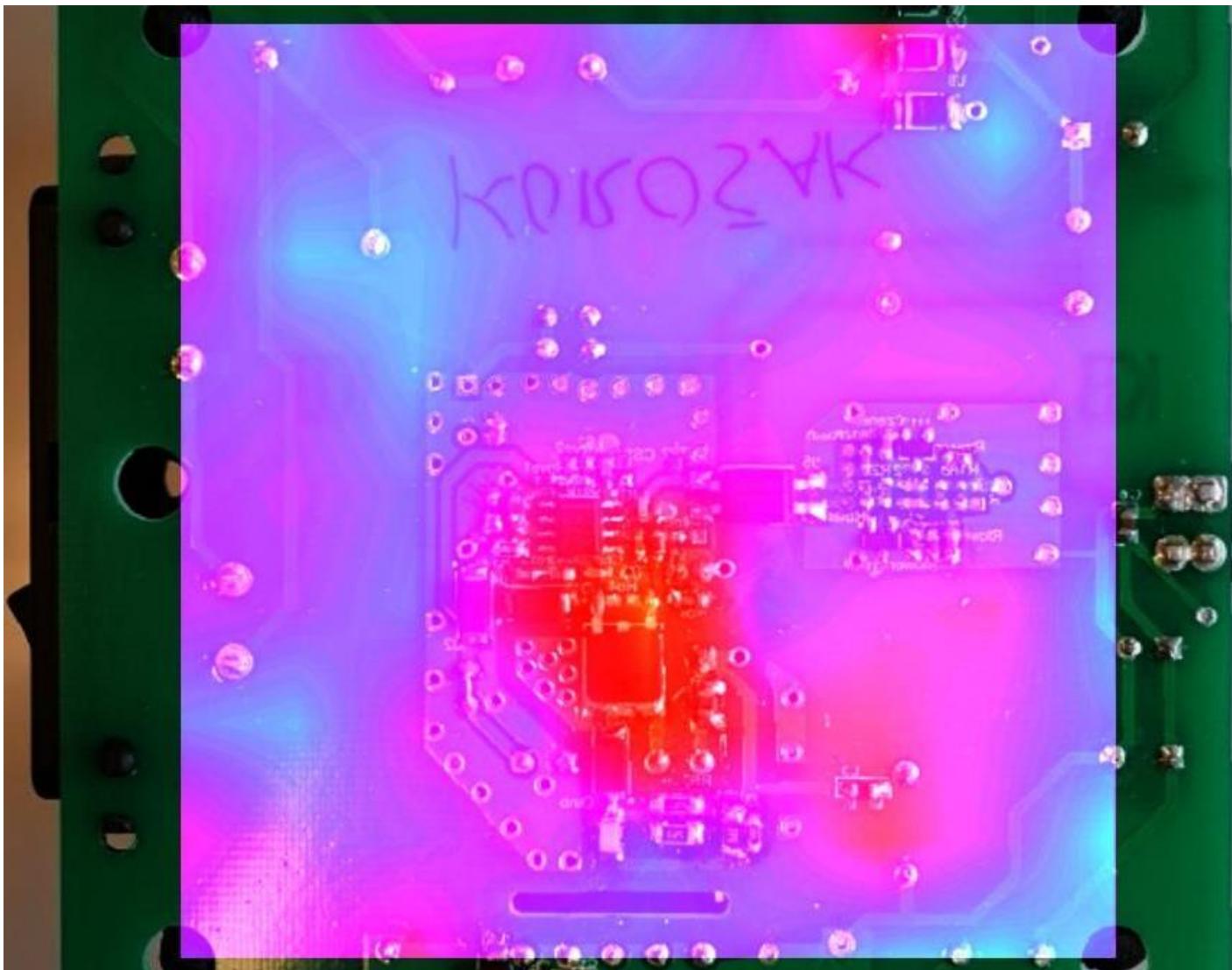
# Žiga Korošak - RE



# Žiga Korošak – E 57MHz



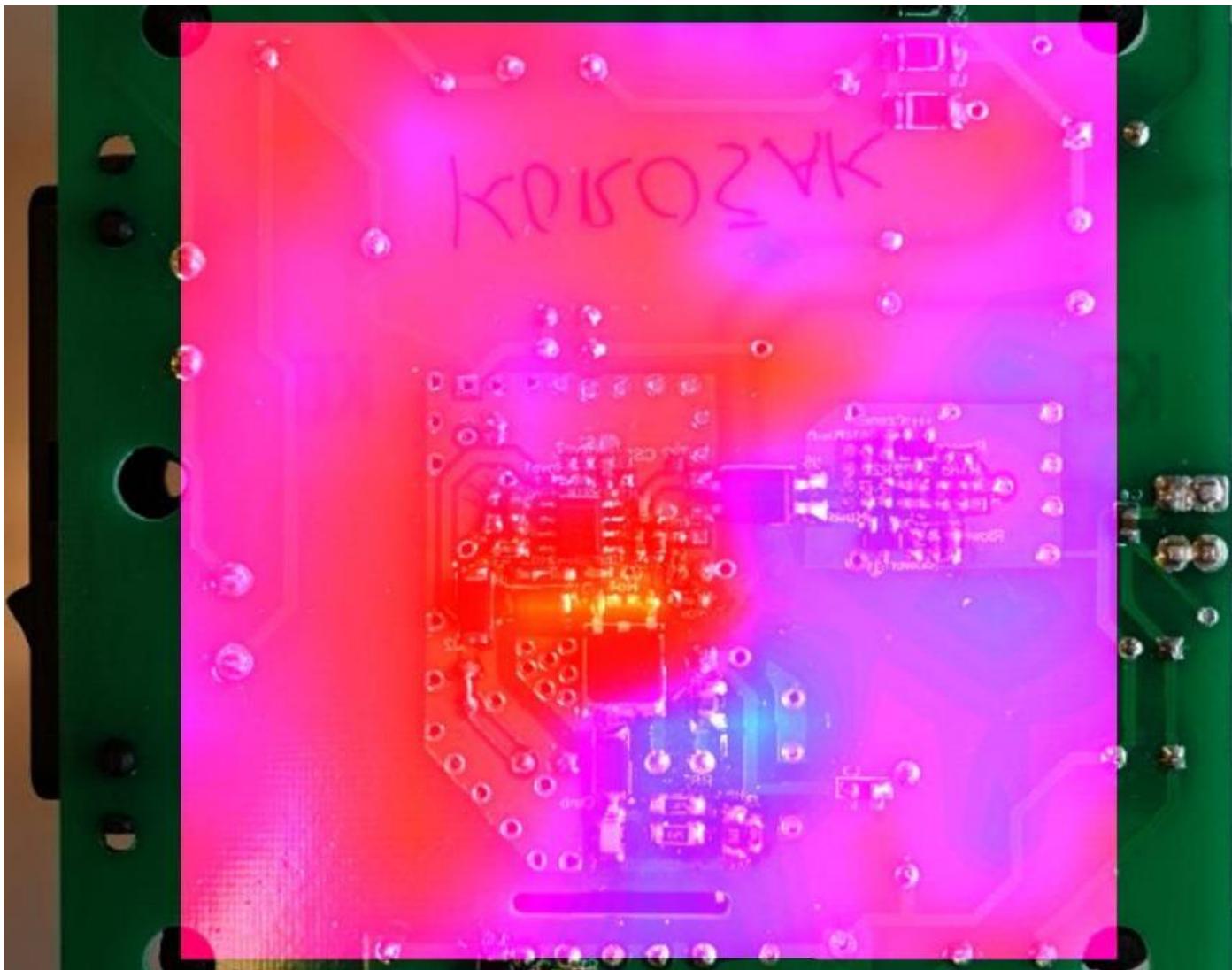
# Žiga Korošak – H 57MHz



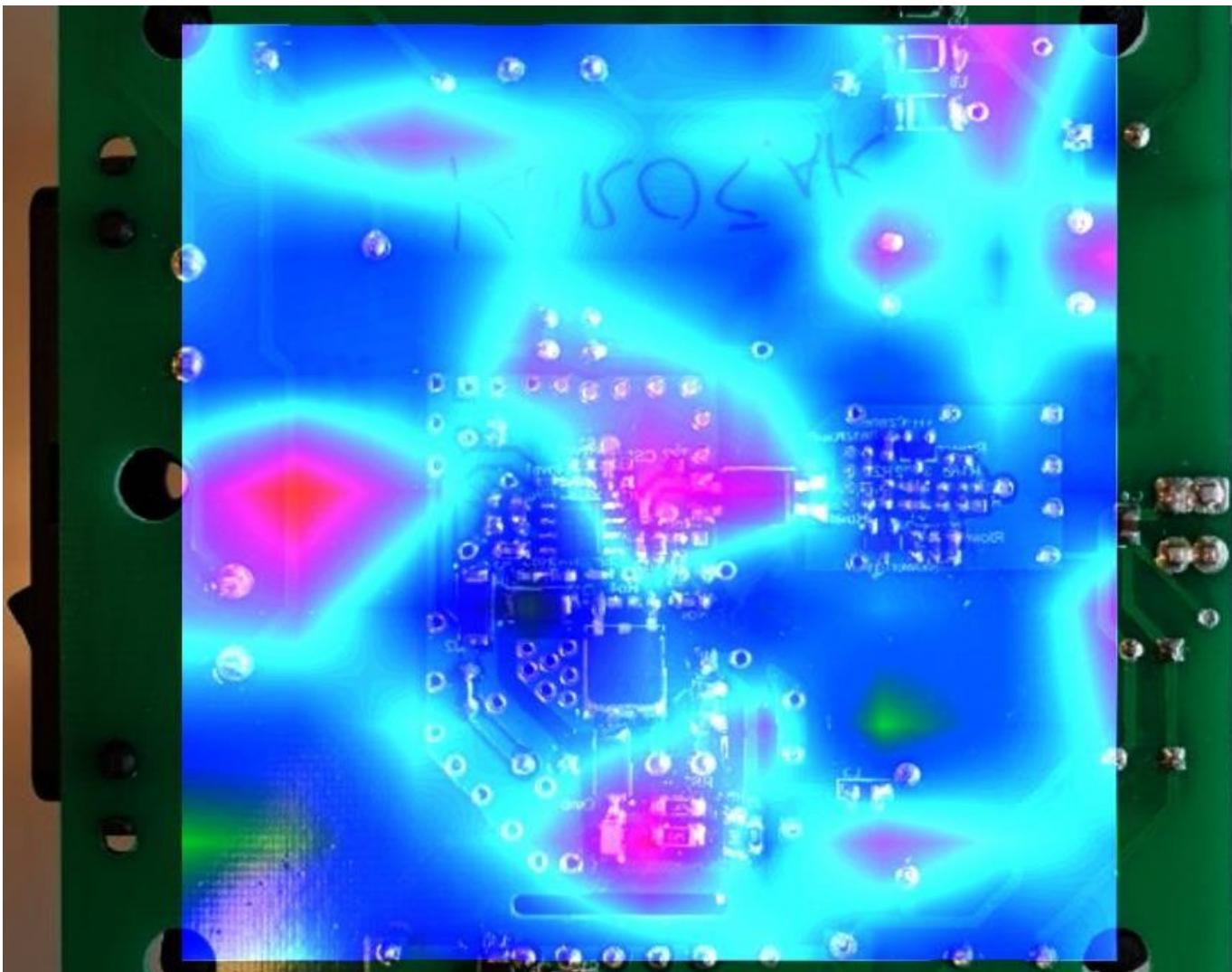
# Žiga Korošak – E 65MHz



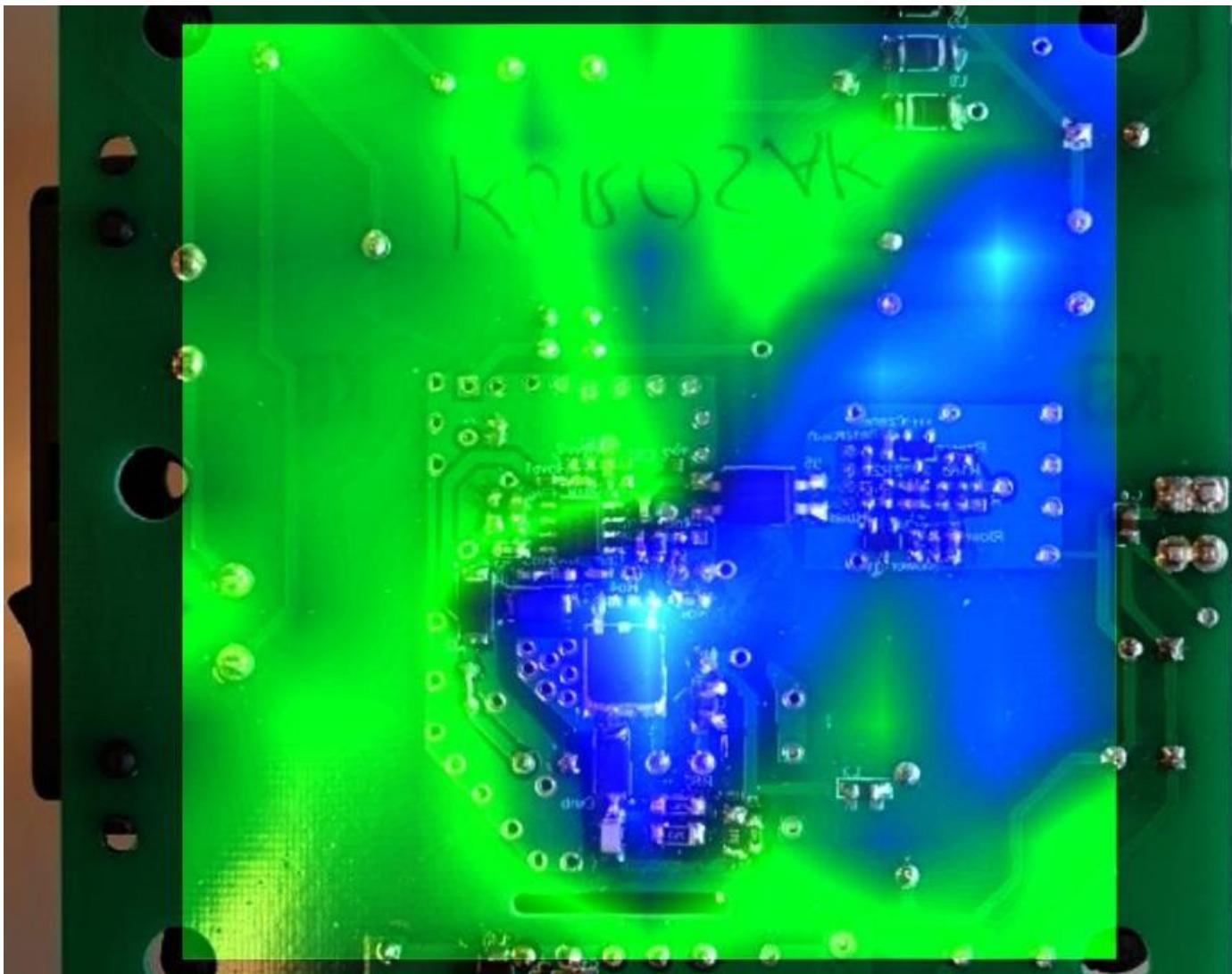
# Žiga Korošak – H 65MHz



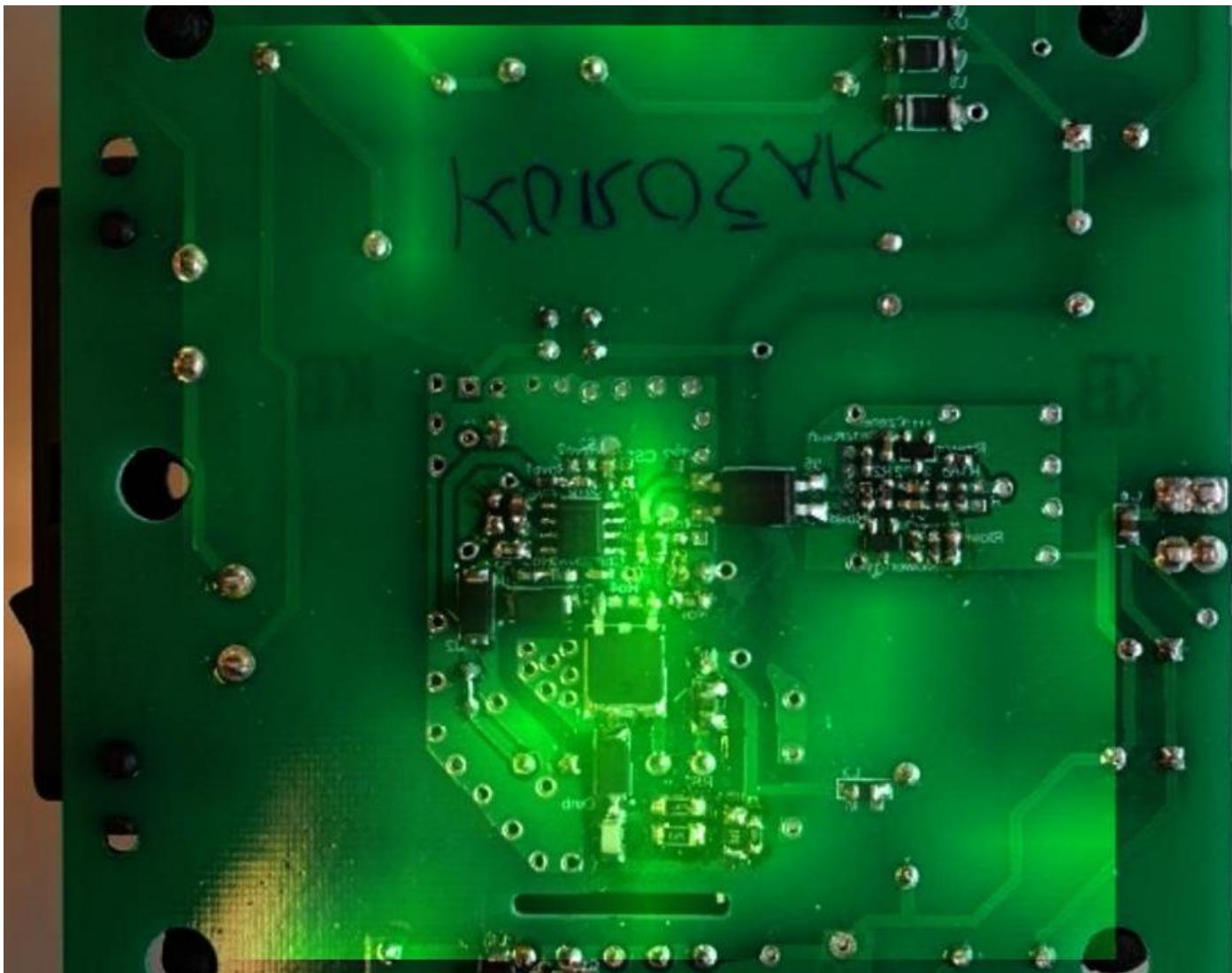
# Žiga Korošak – E 85MHz



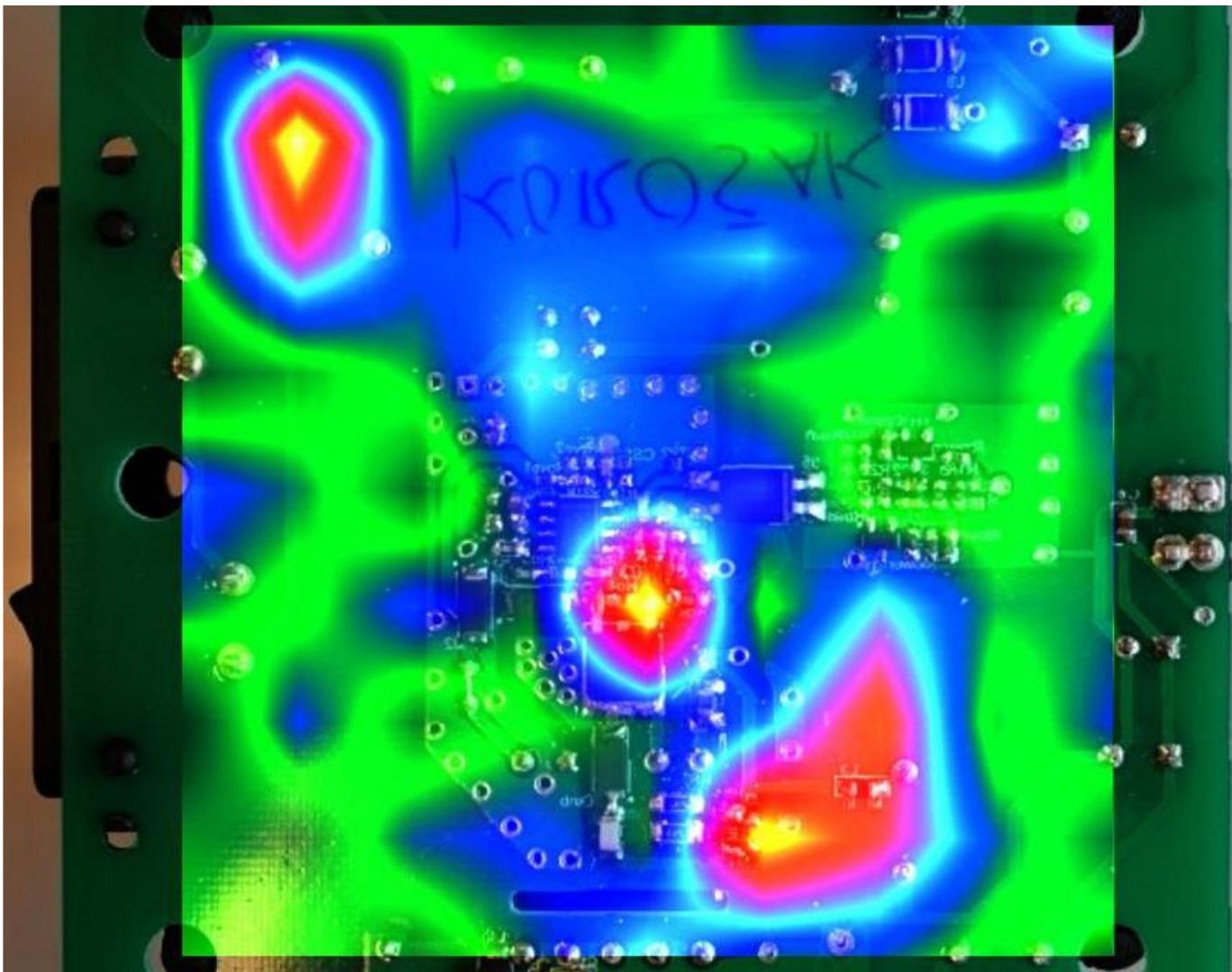
# Žiga Korošak – H 85MHz



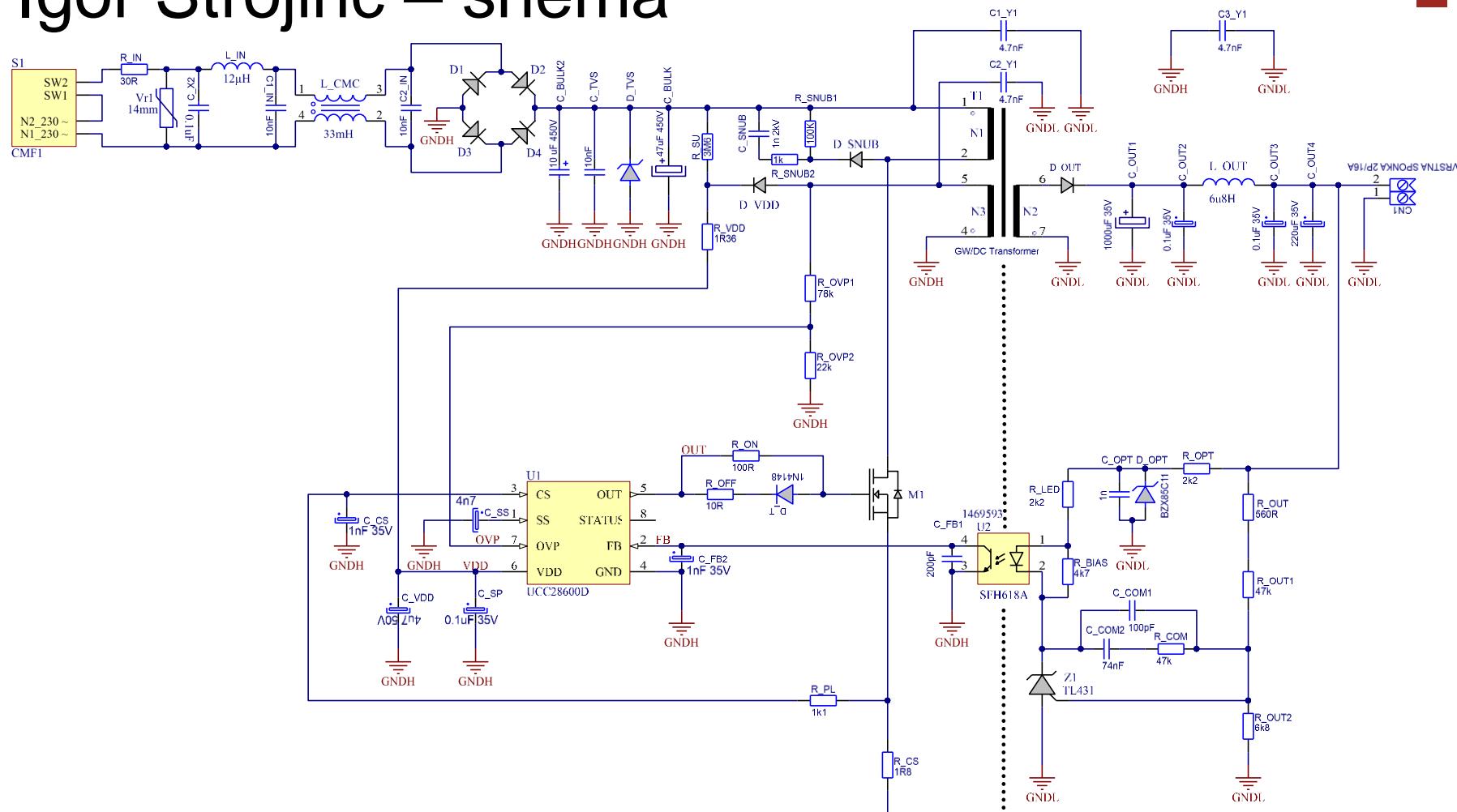
# Žiga Korošak – E 142MHz



# Žiga Korošak – H 142MHz

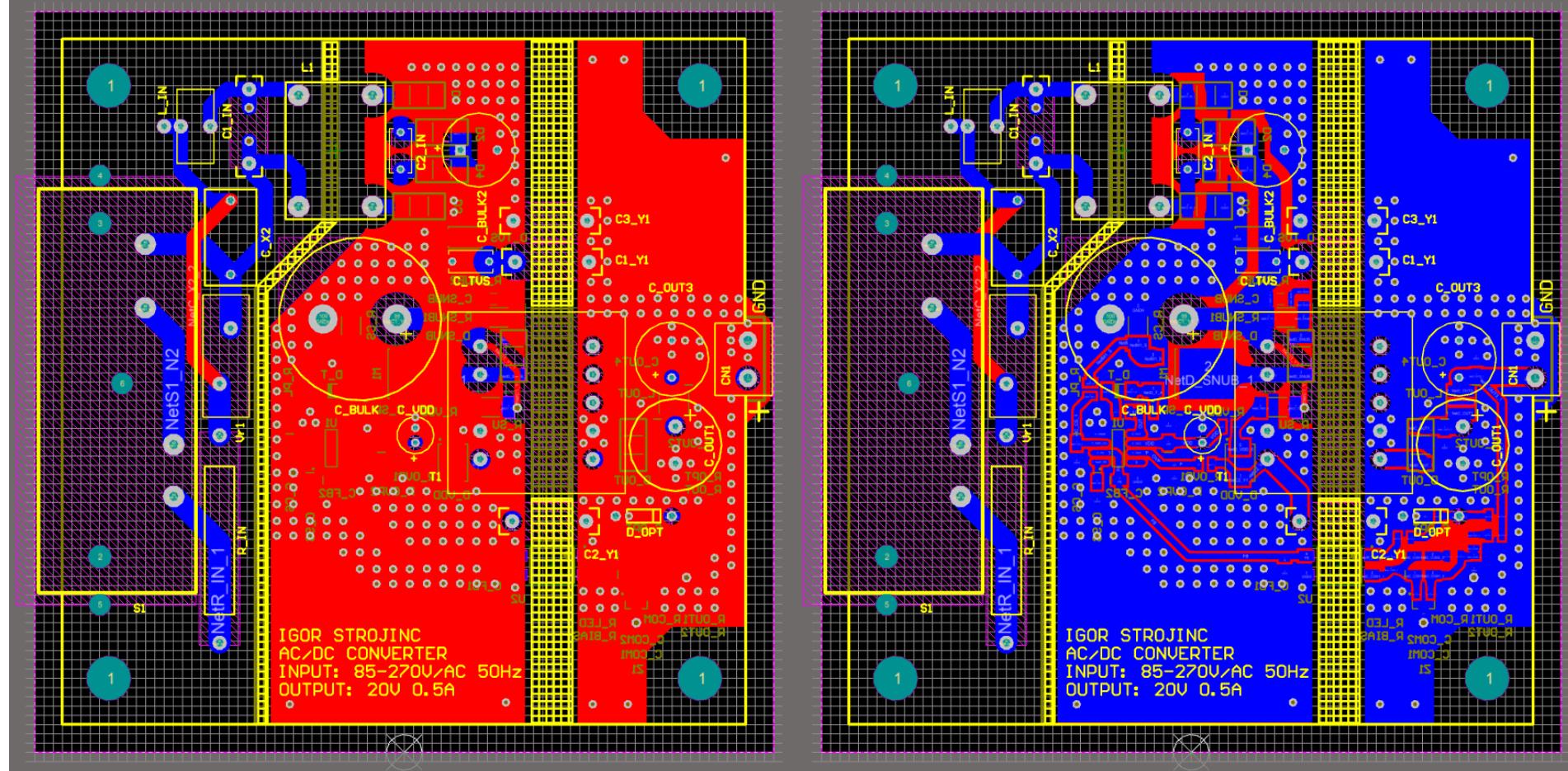


# Igor Strojinc – shema

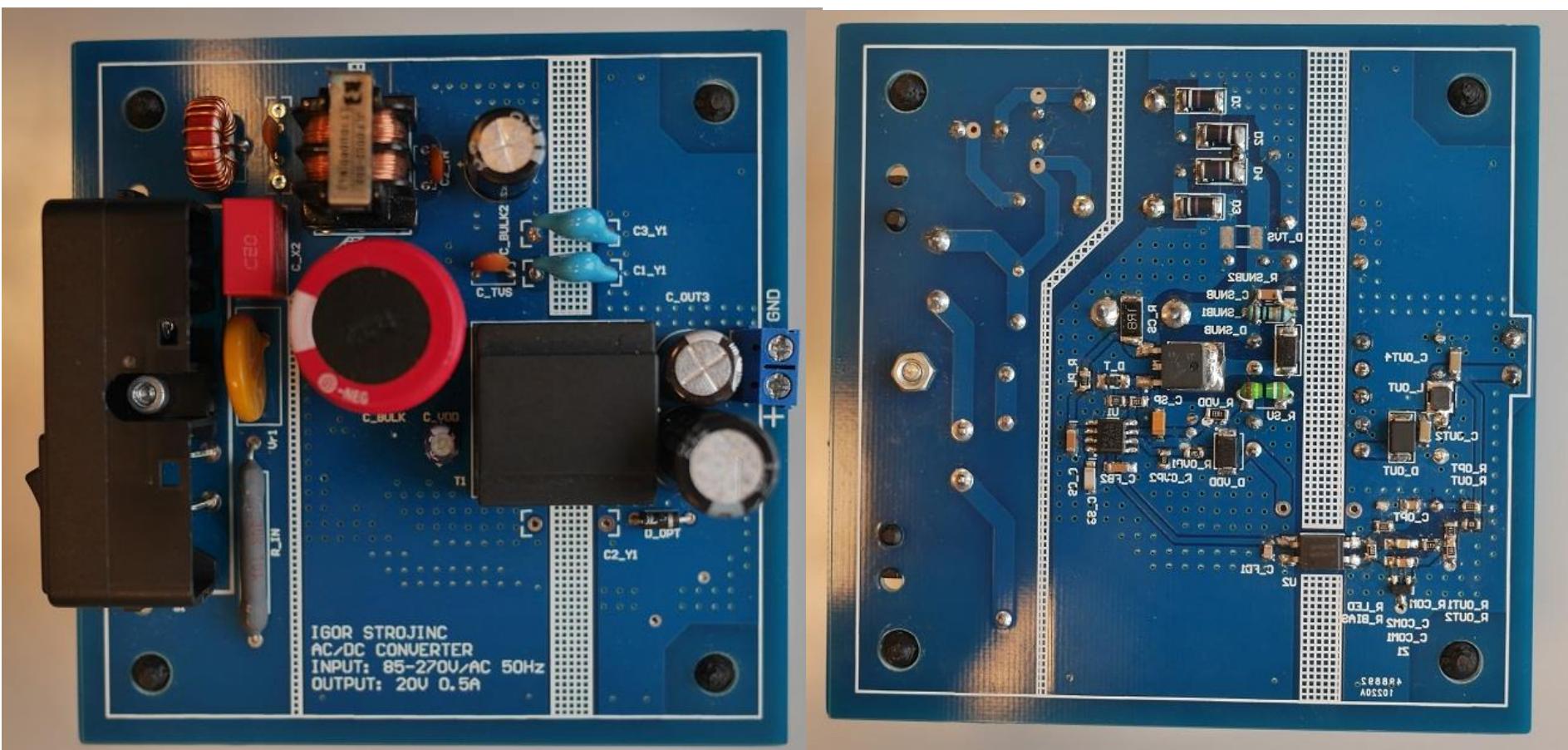


Uizh /0	Uizh 1W	Uizh 10W	ripple 1W	ripple 10W	HF šum
19.74 V	19.74 V	19.7 V	23 mV	5 mV	40 mV

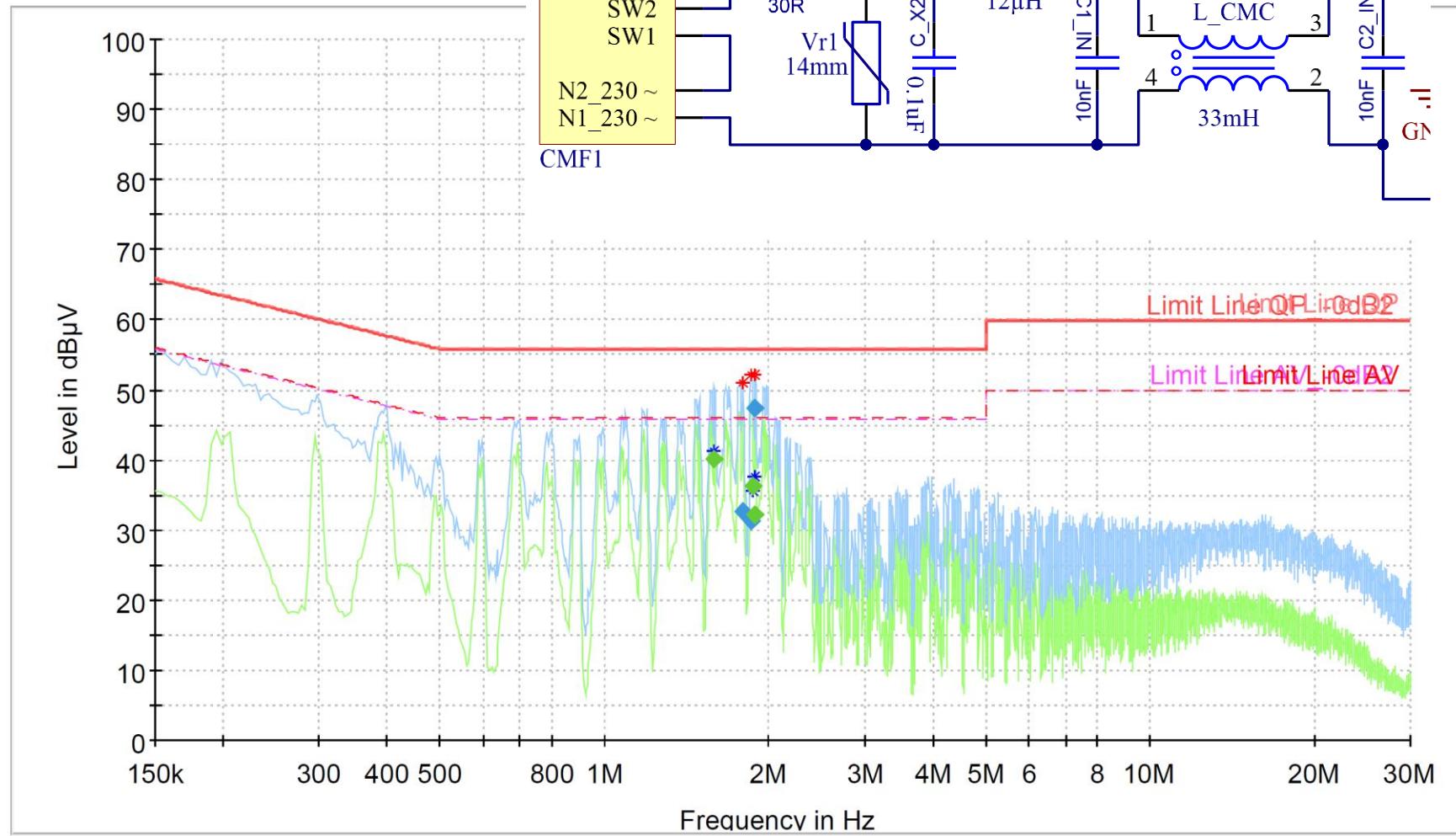
# Igor Strojinc – načrt TIV



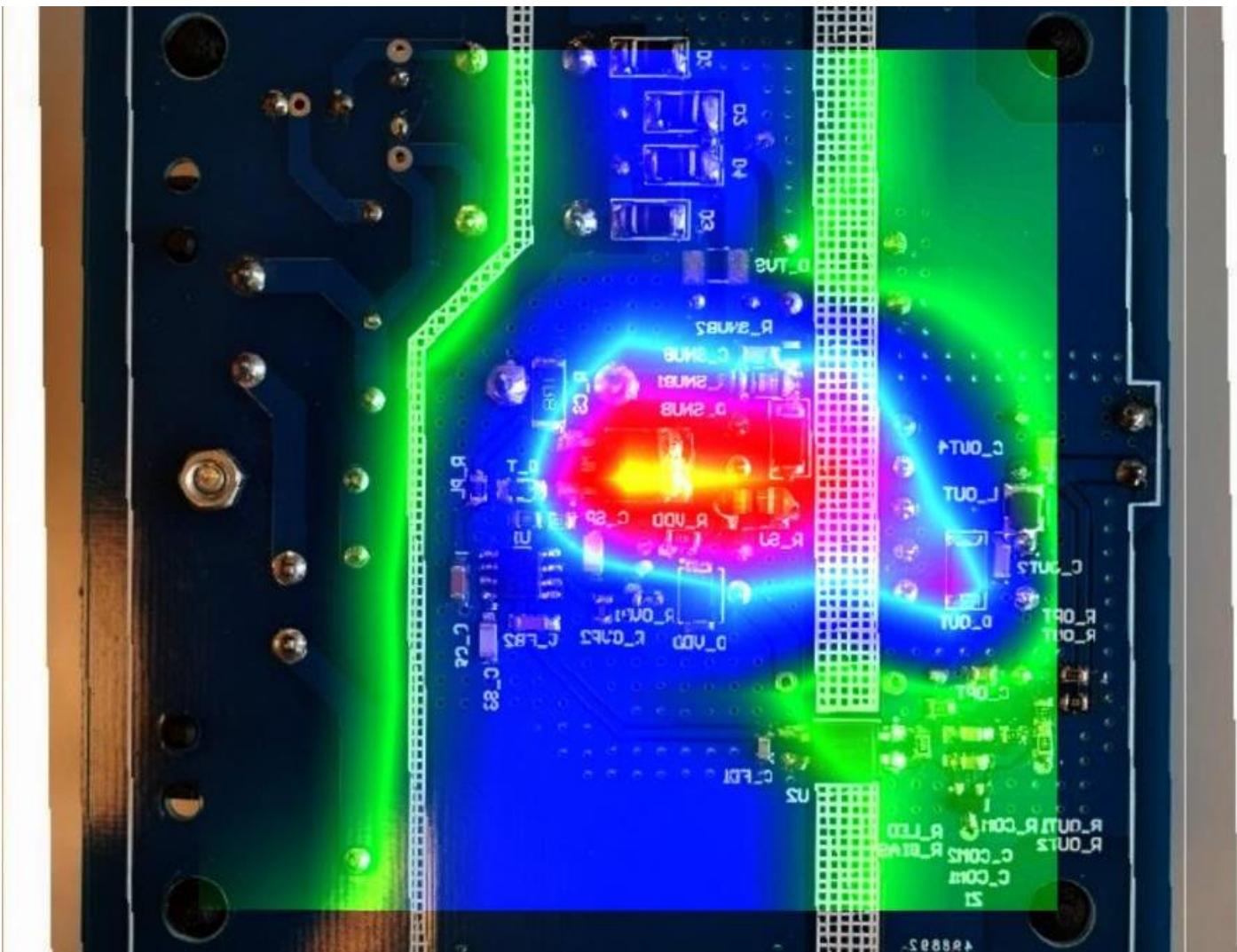
# Igor Strojinc – izdelano TIV



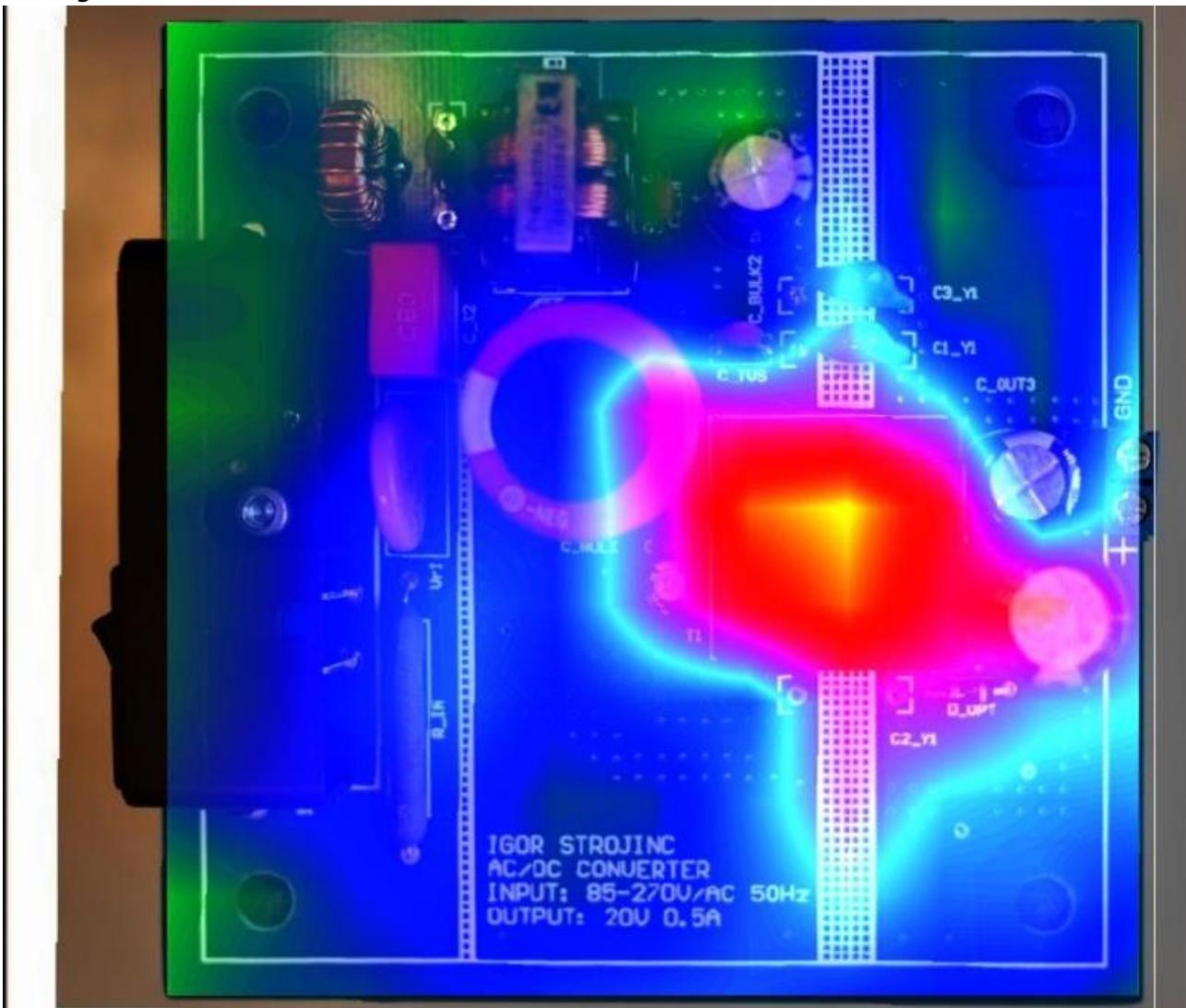
# Igor Strojinc - CE



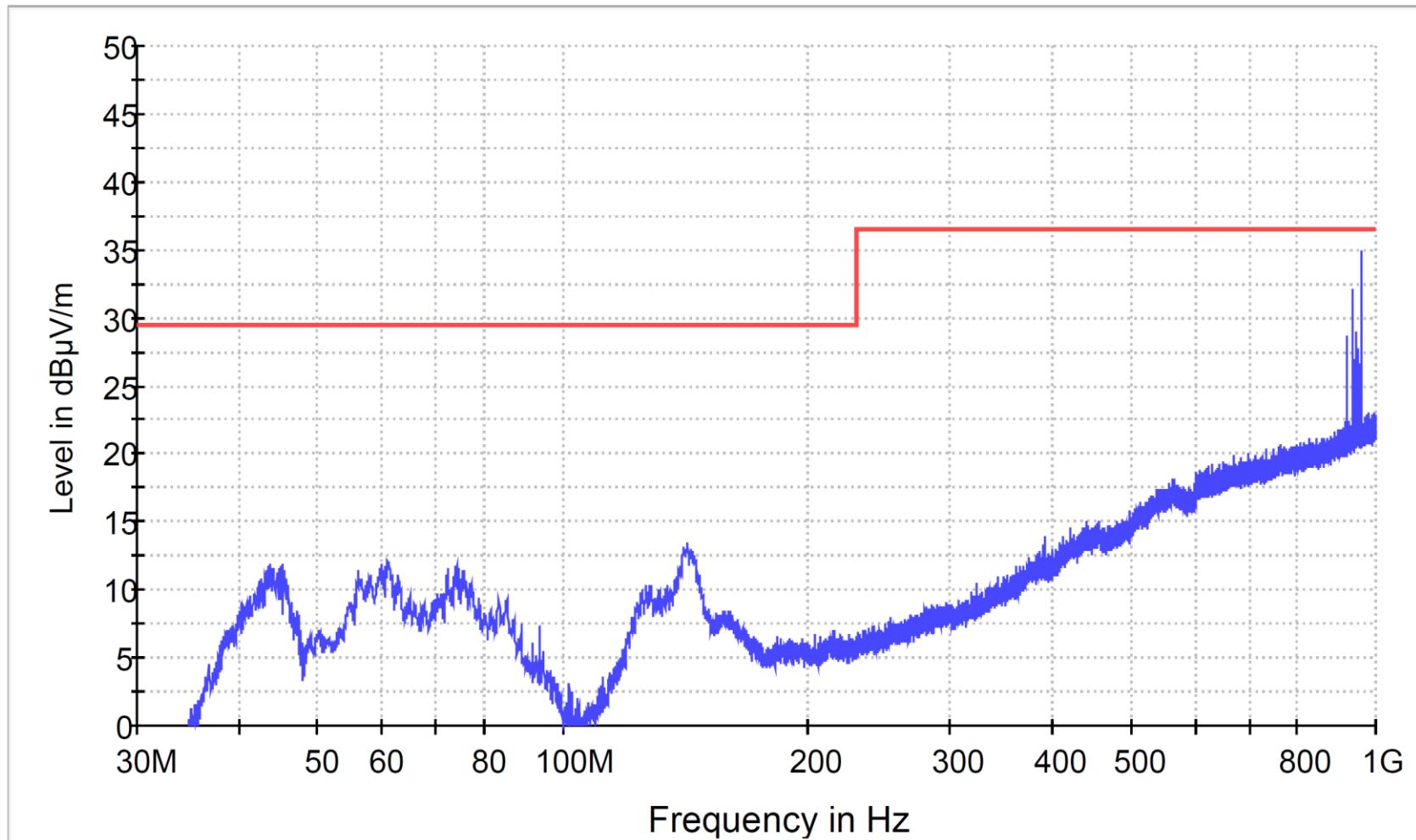
# Igor Strojinc – E 284kHz



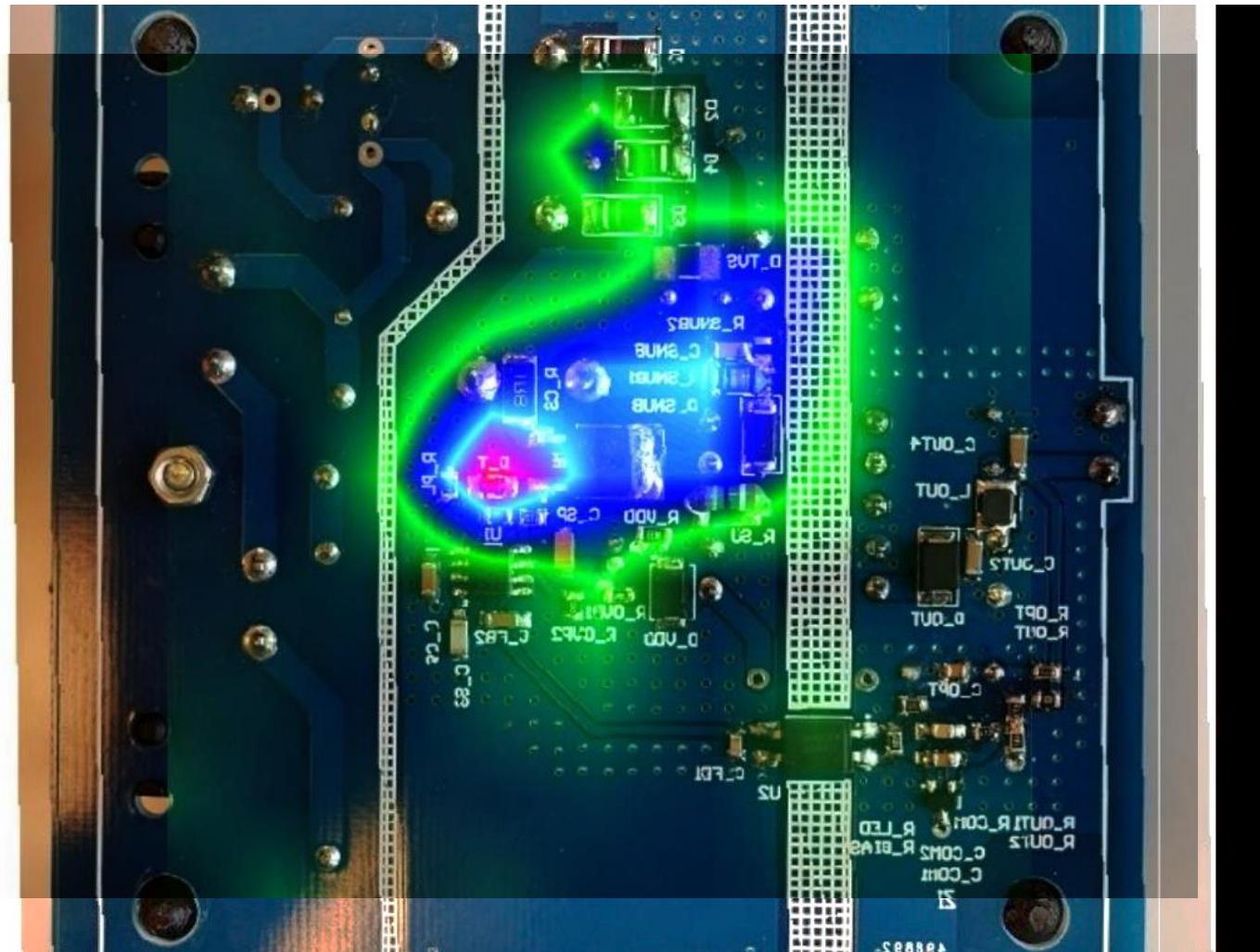
# Igor Strojinc – H 284kHz



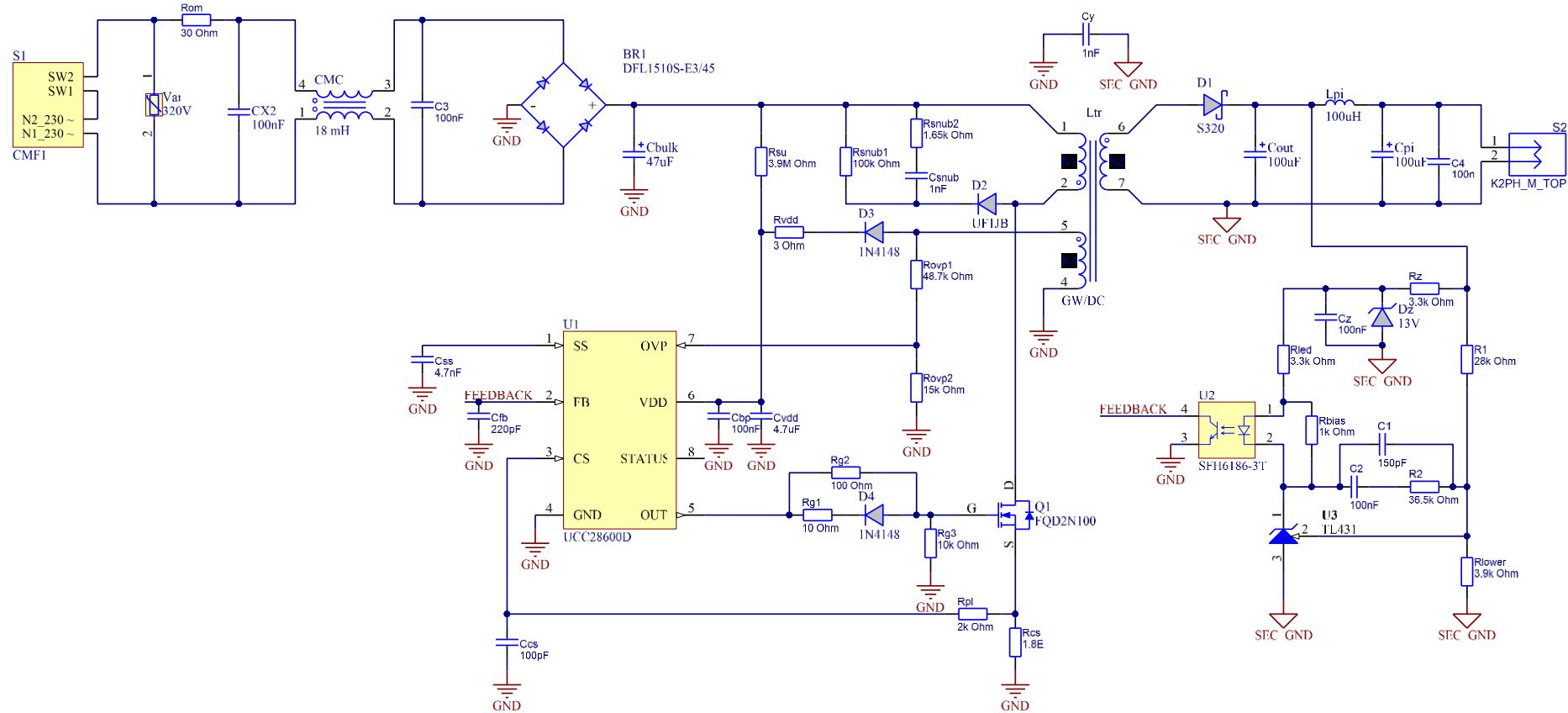
# Igor Strojinc - RE



# Igor Strojinc – H 74MHz

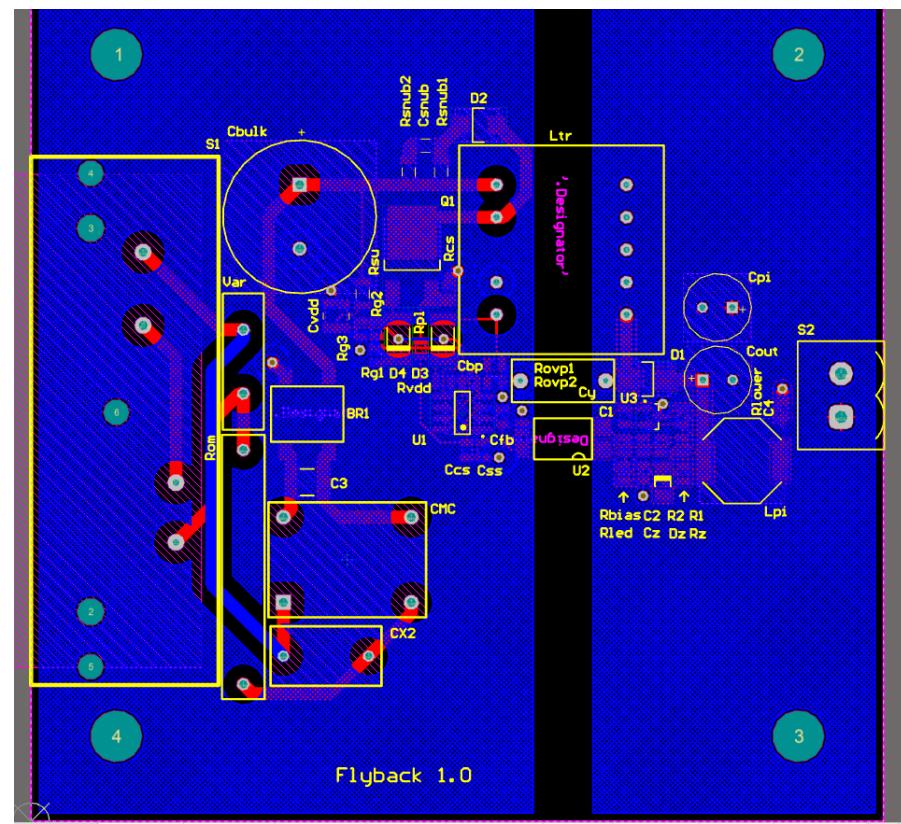
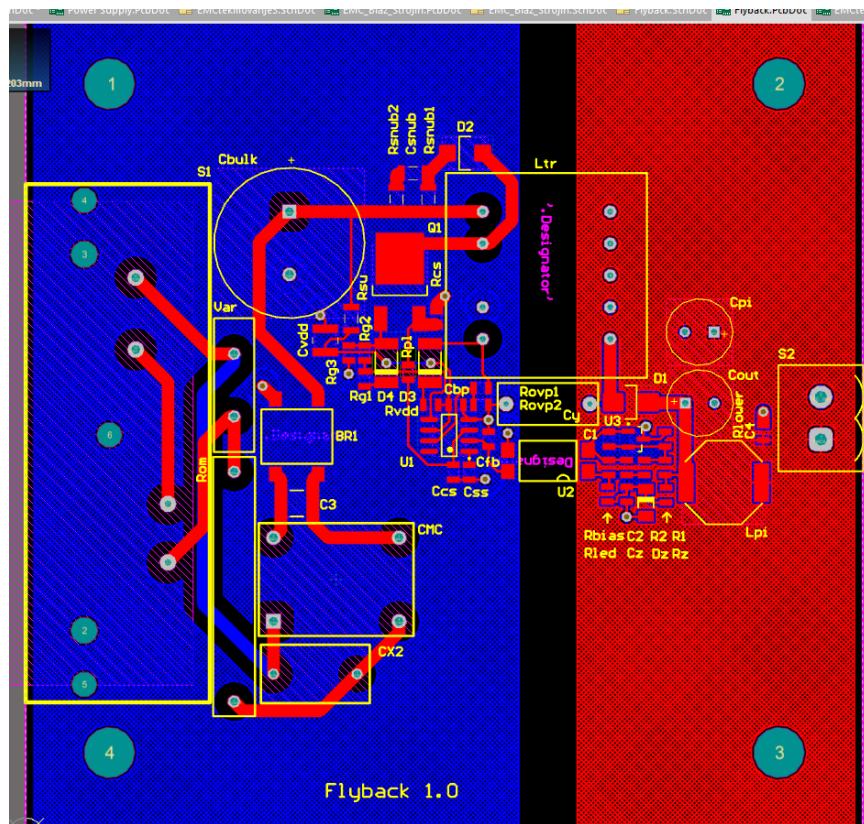


# Luka Rupar – shema

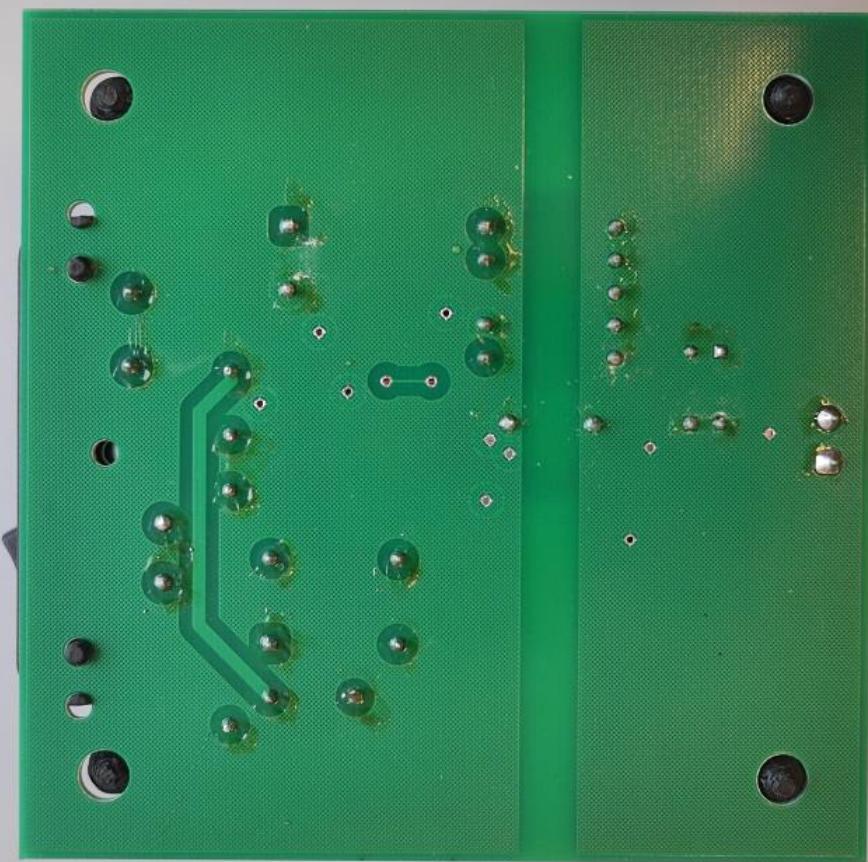
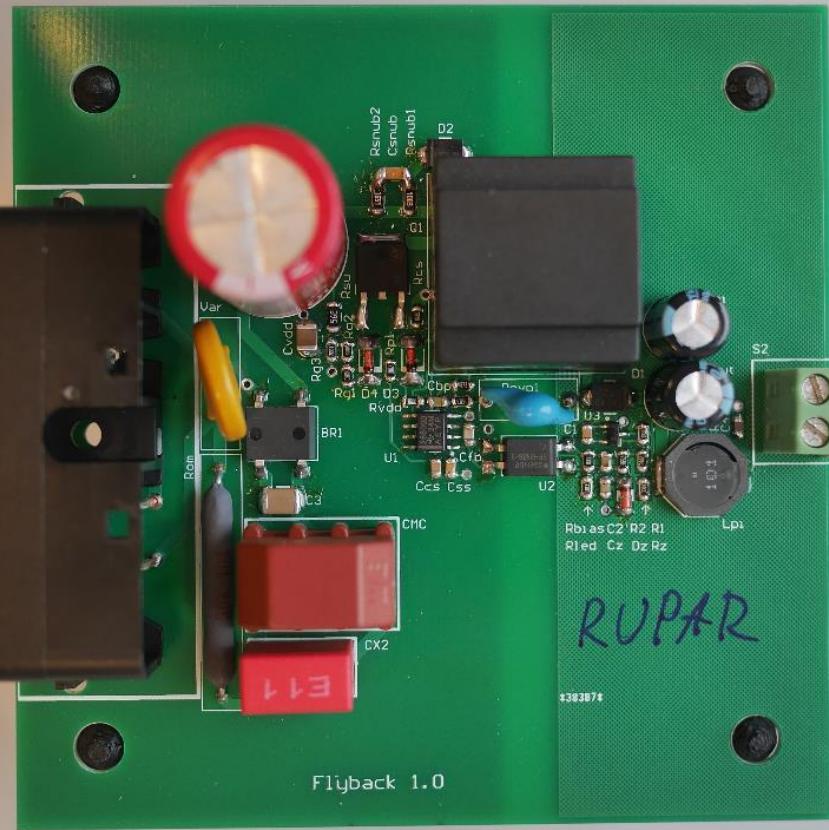


U <sub>izh</sub> /0	U <sub>izh</sub> 1W	U <sub>izh</sub> 10W	ripple 1W	ripple 10W	HF šum
<b>20.43 V</b>	<b>20.41 V</b>	<b>20.25 V</b>	<b>7 mV</b>	<b>10 mV</b>	

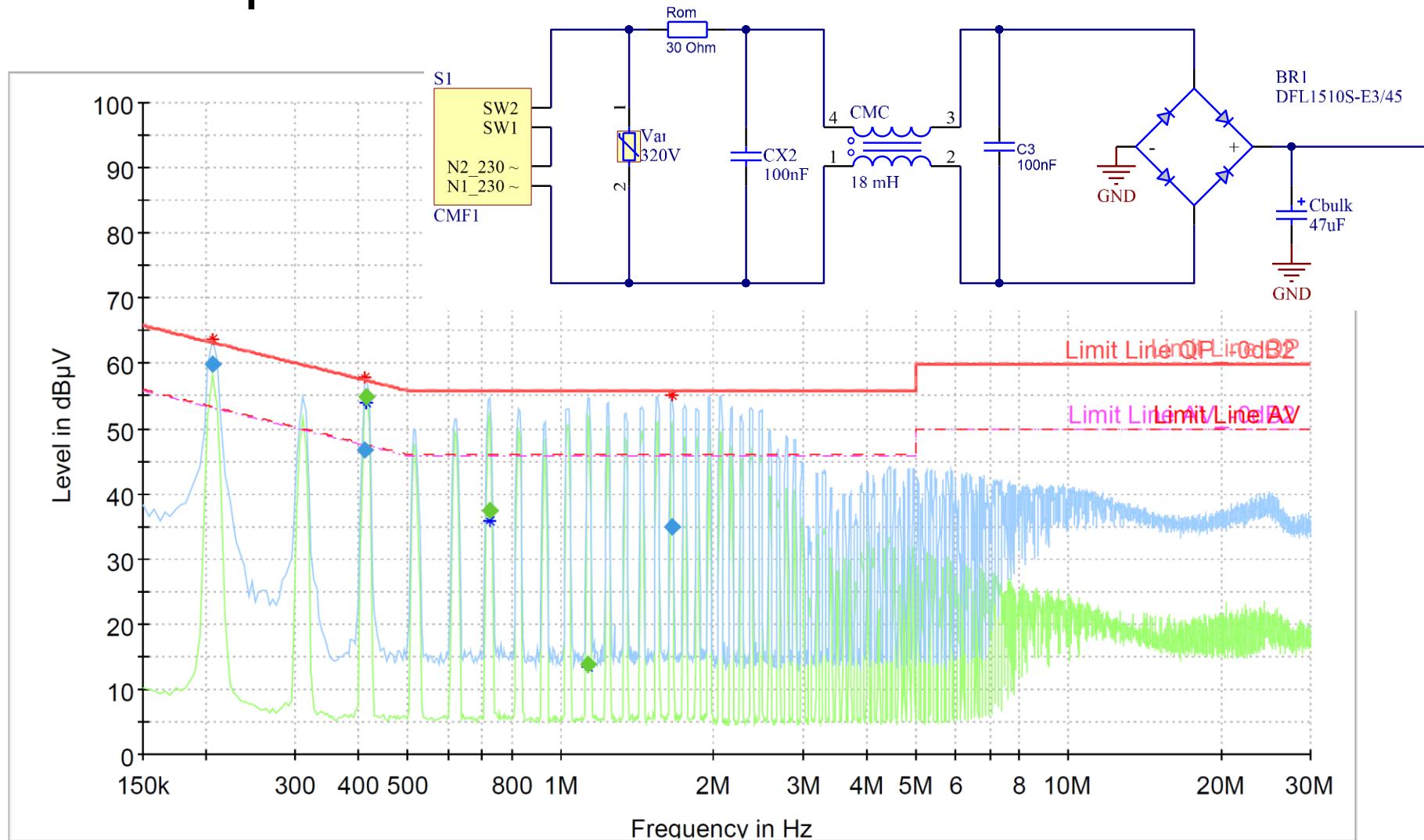
# Luka Rupar – načrt TIV



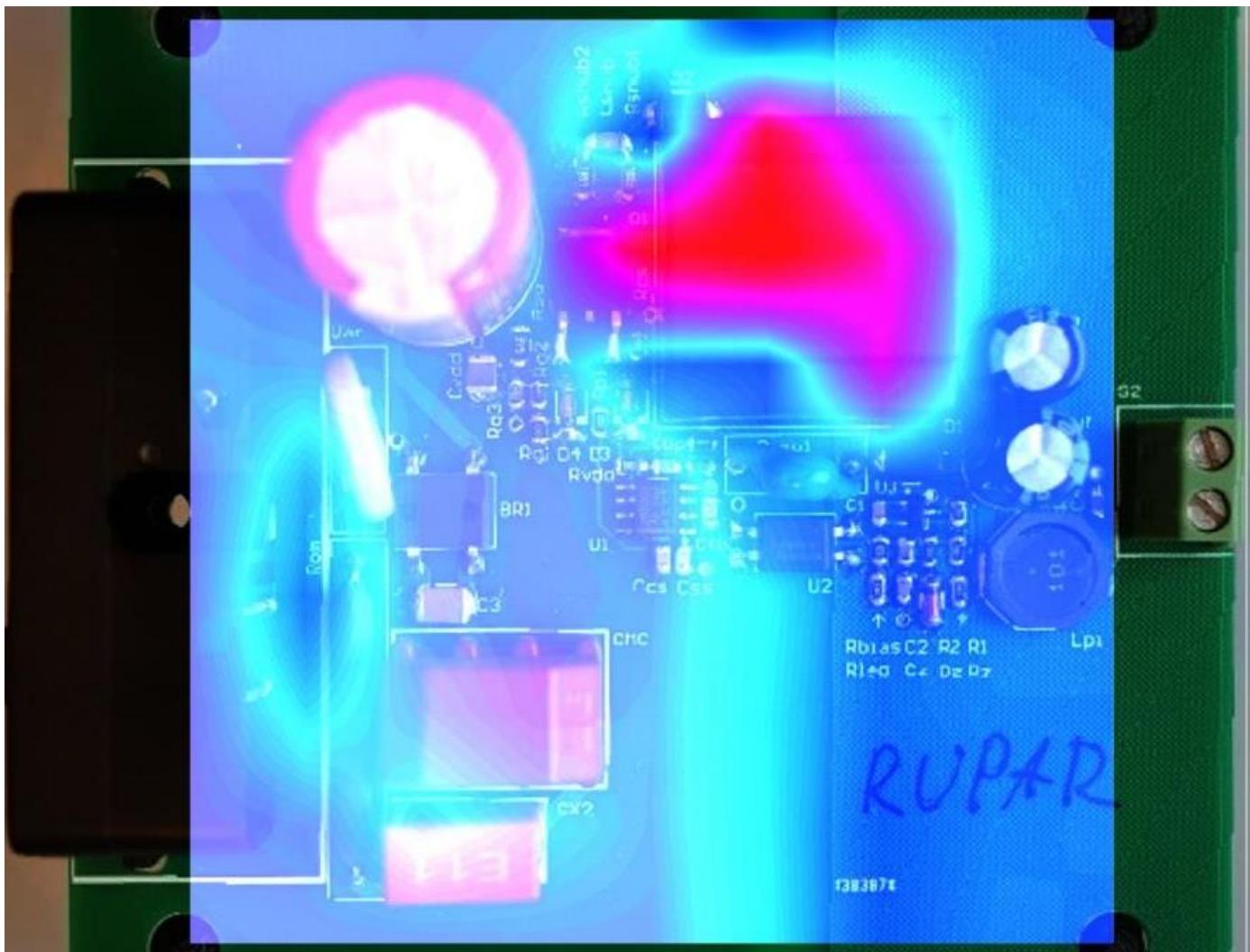
# Luka Rupar – izdelano TIV



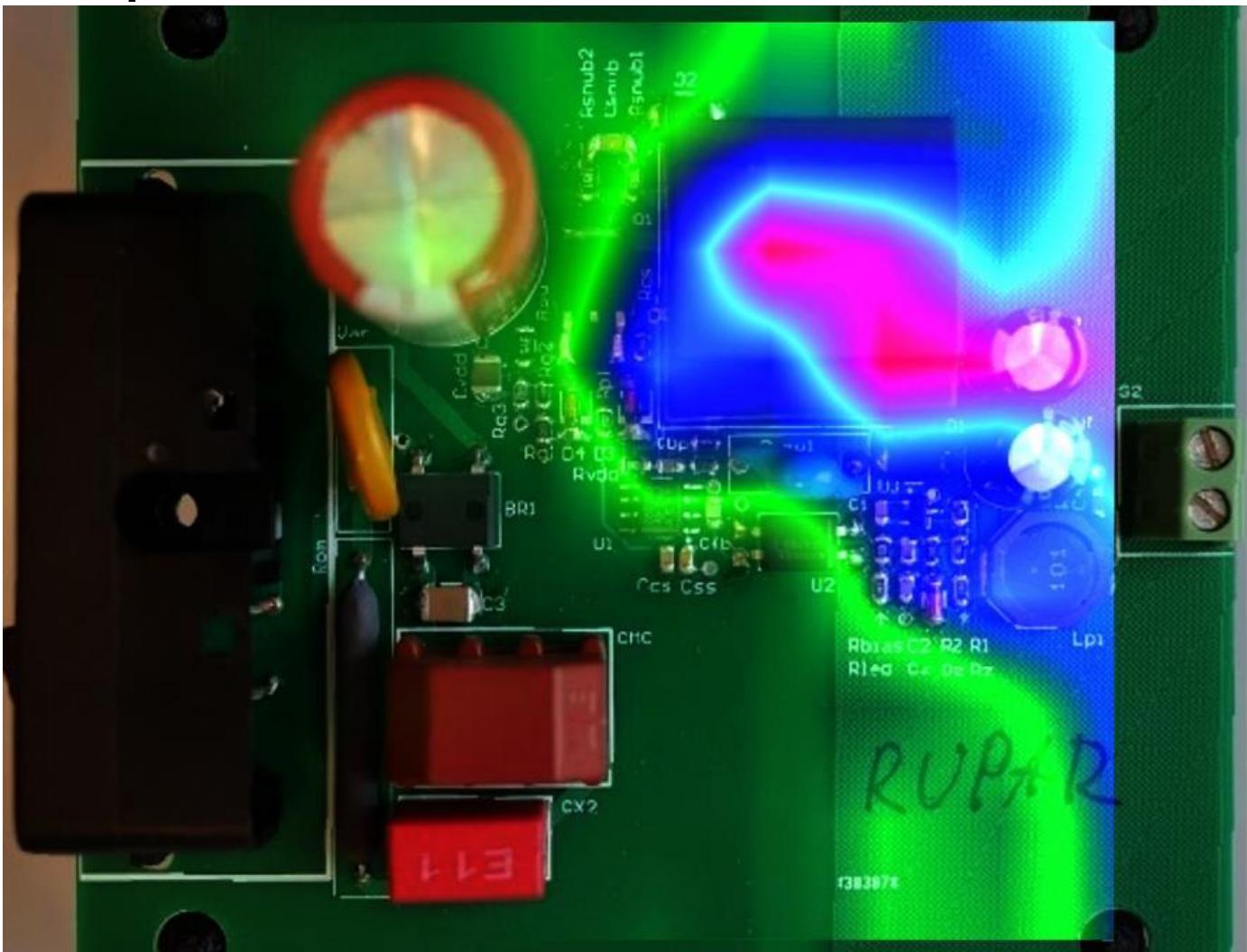
# Luka Rupar - CE



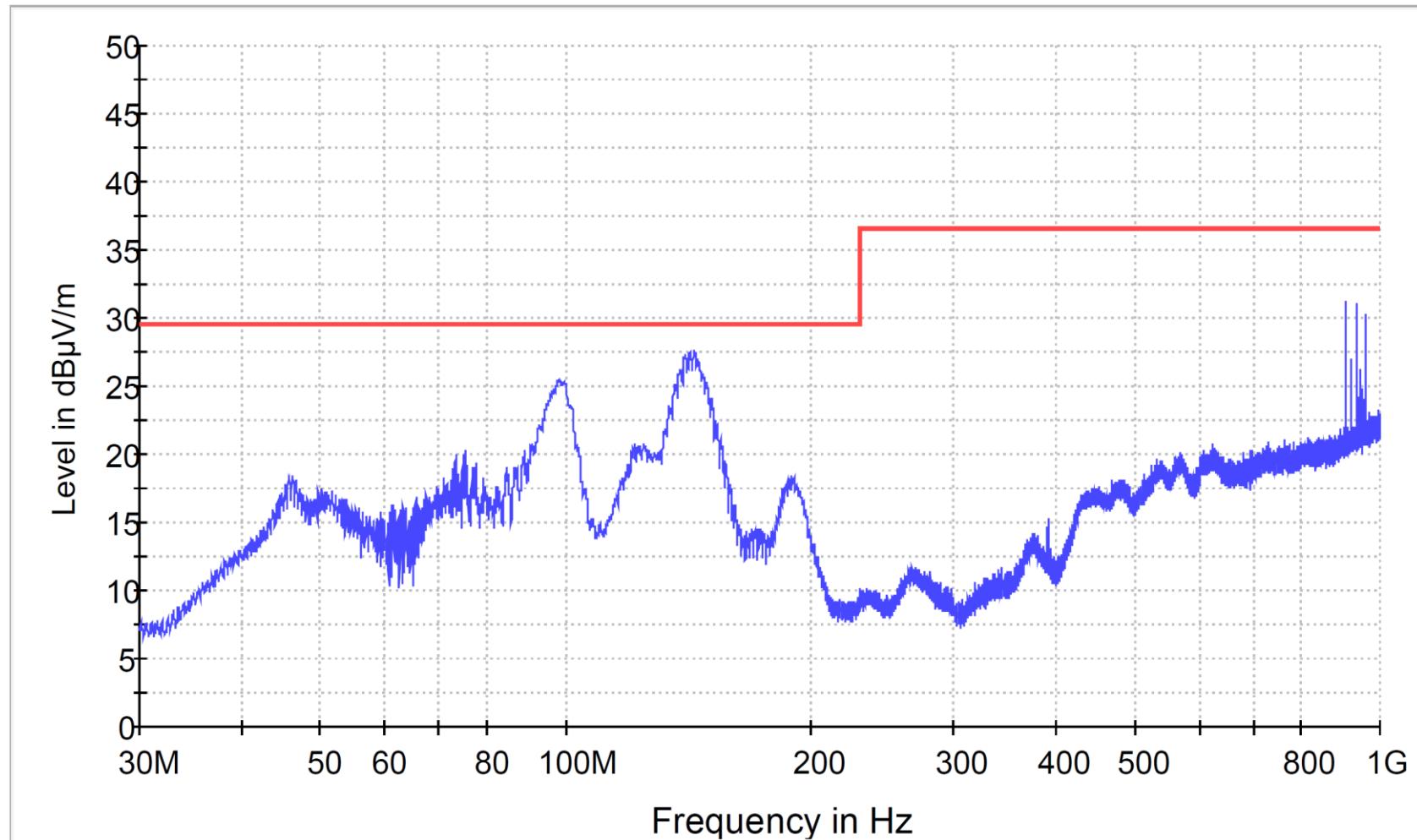
# Luka Rupar – E 197kHz



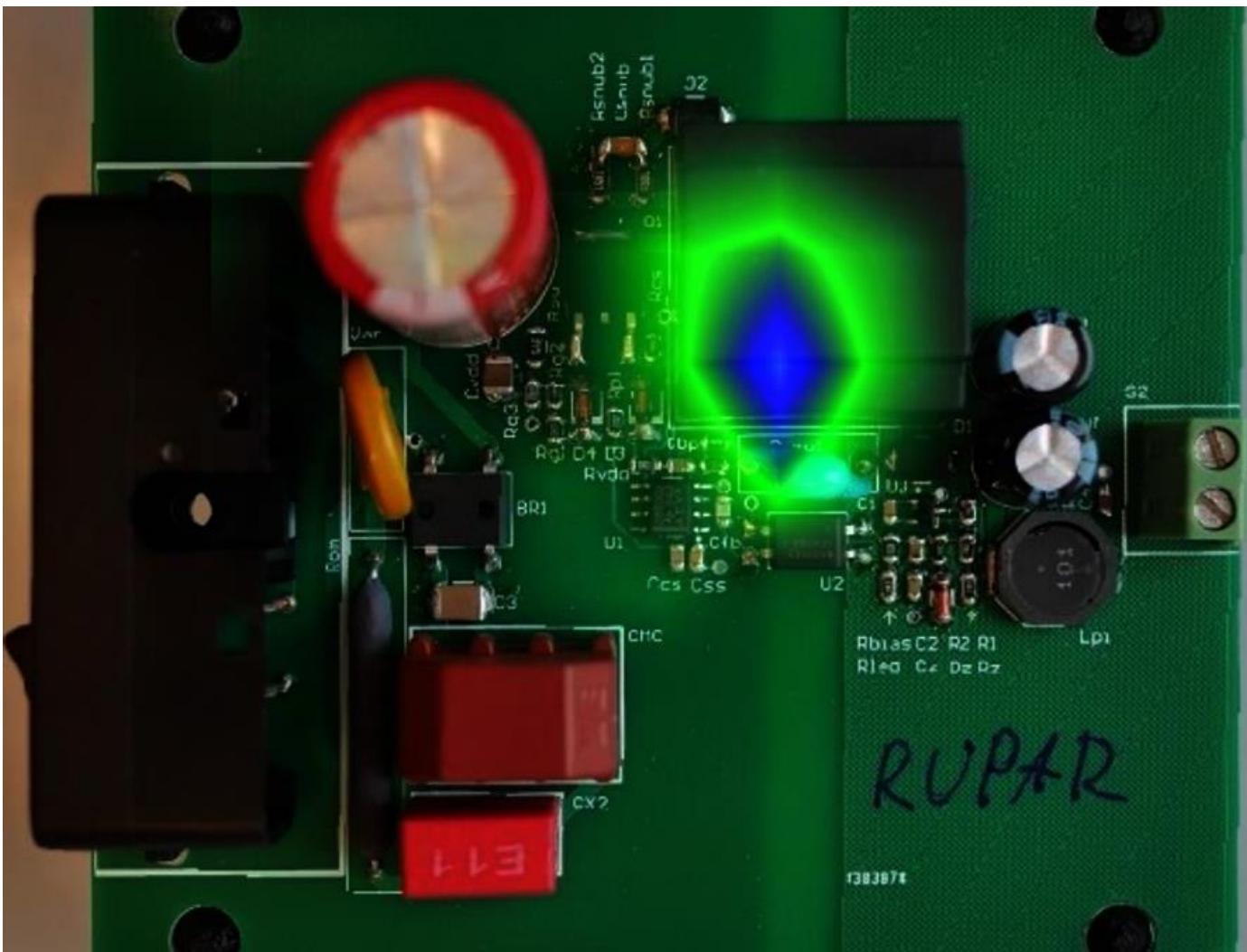
# Luka Rupar – H 197kHz



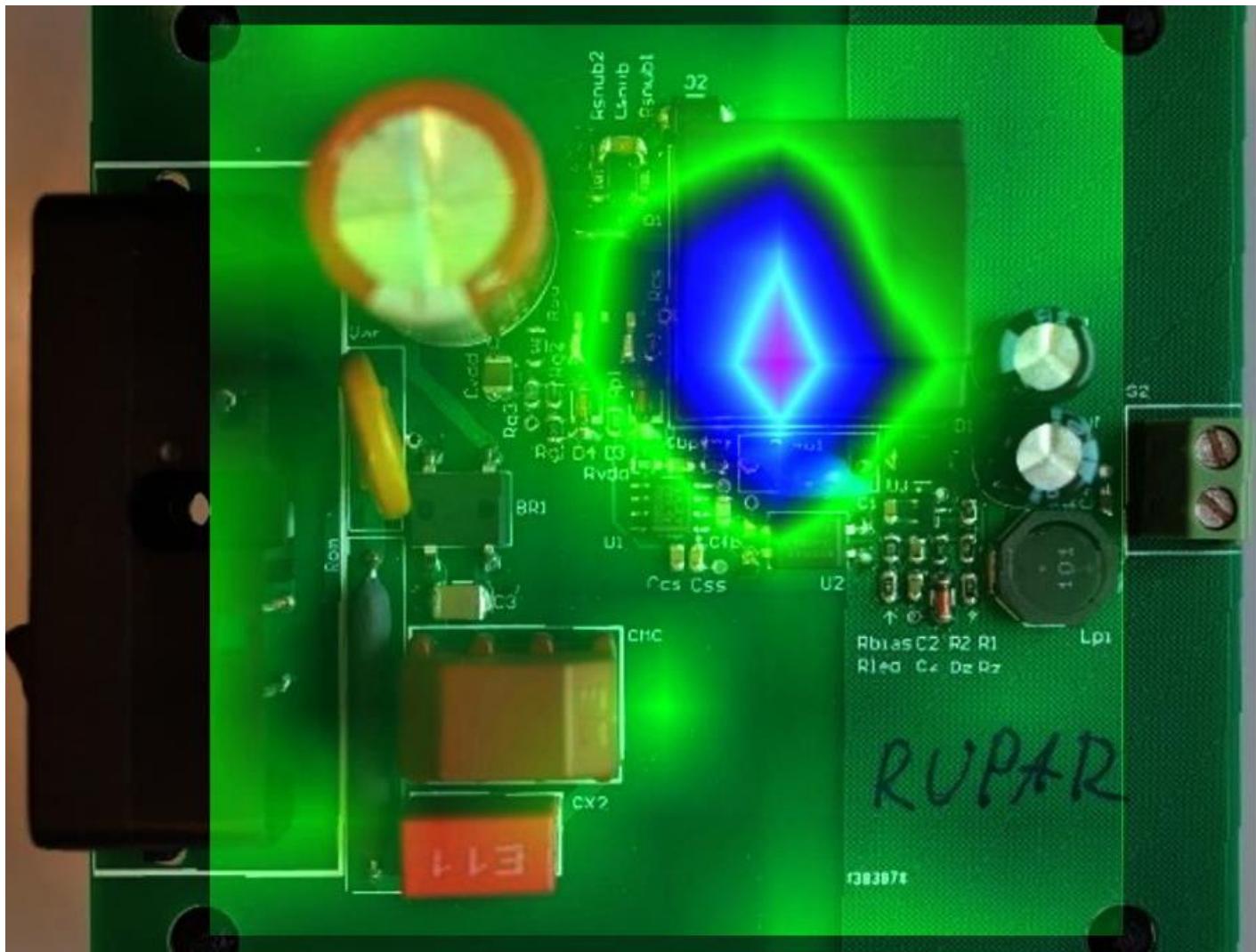
# Luka Rupar - RE



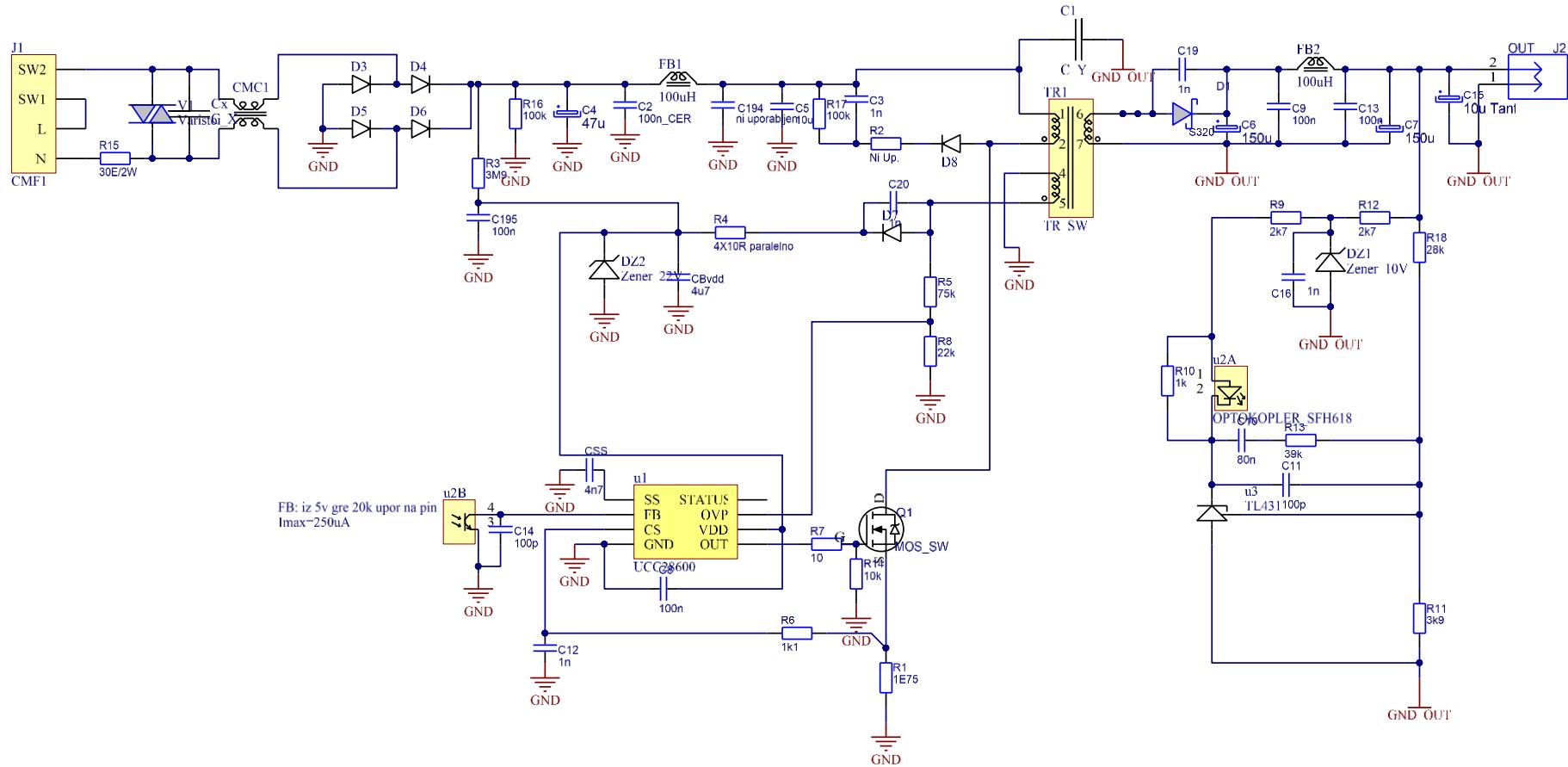
# Luka Rupar – E 147MHz



# Luka Rupar – H 147MHz

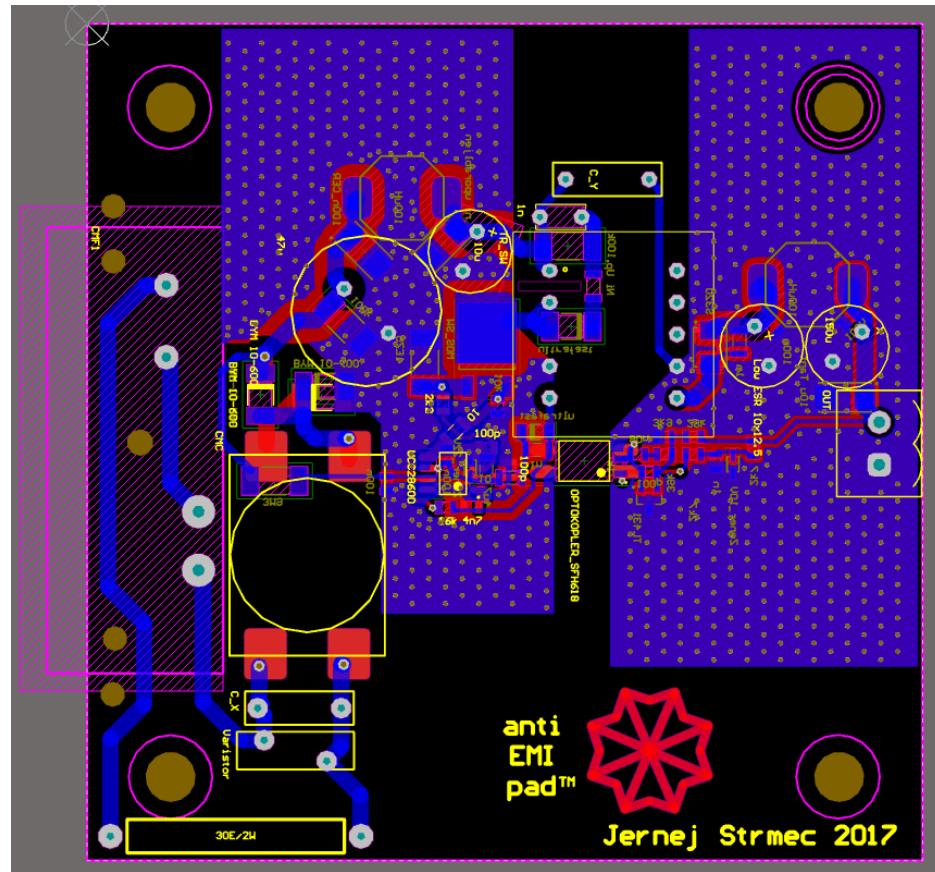
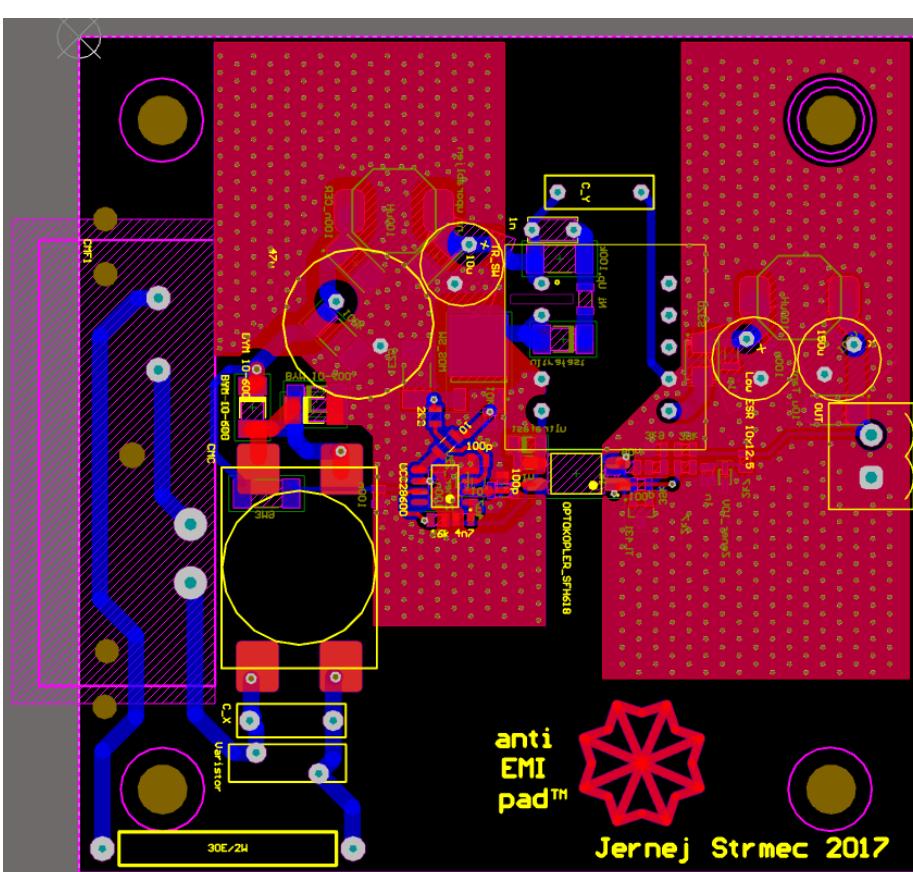


# Jernej Strmec – shema

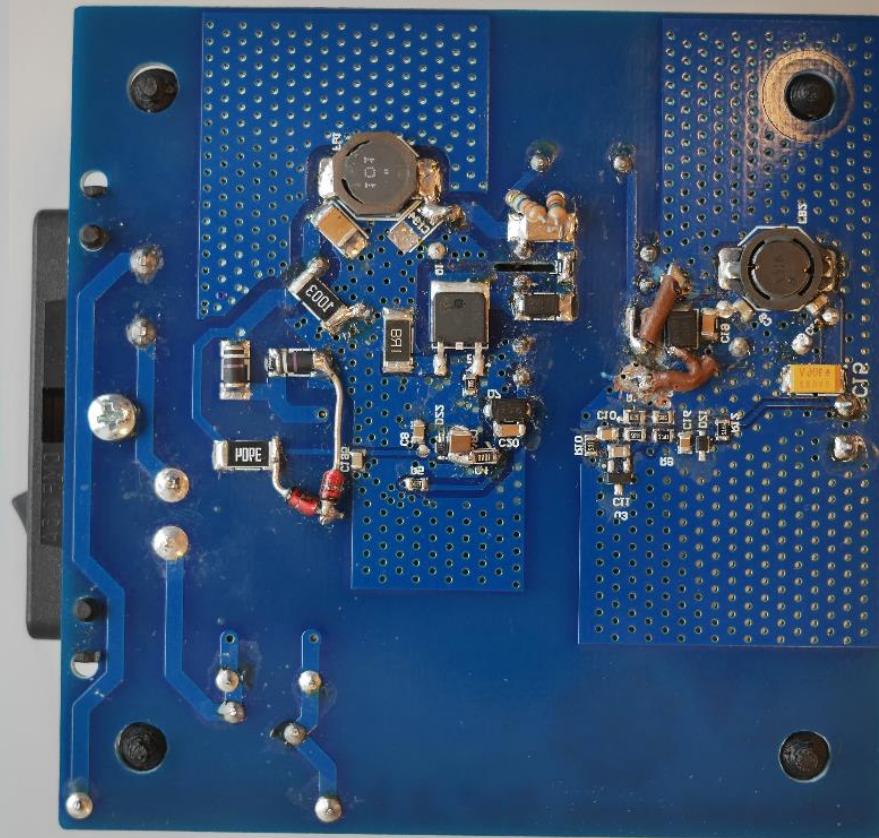
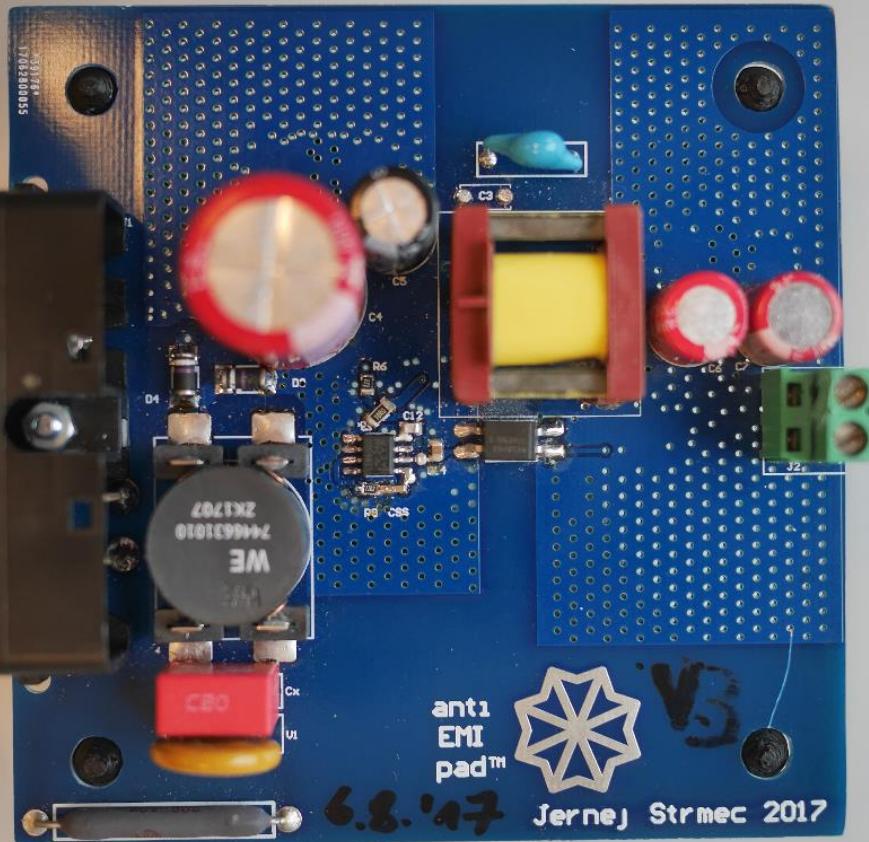


U <sub>izh</sub> /0	U <sub>izh</sub> 1W	U <sub>izh</sub> 10W	ripple 1W	ripple 10W	HF šum
20.37 V	20.26 V	20.16 V	200 mV	20 mV	40 mV

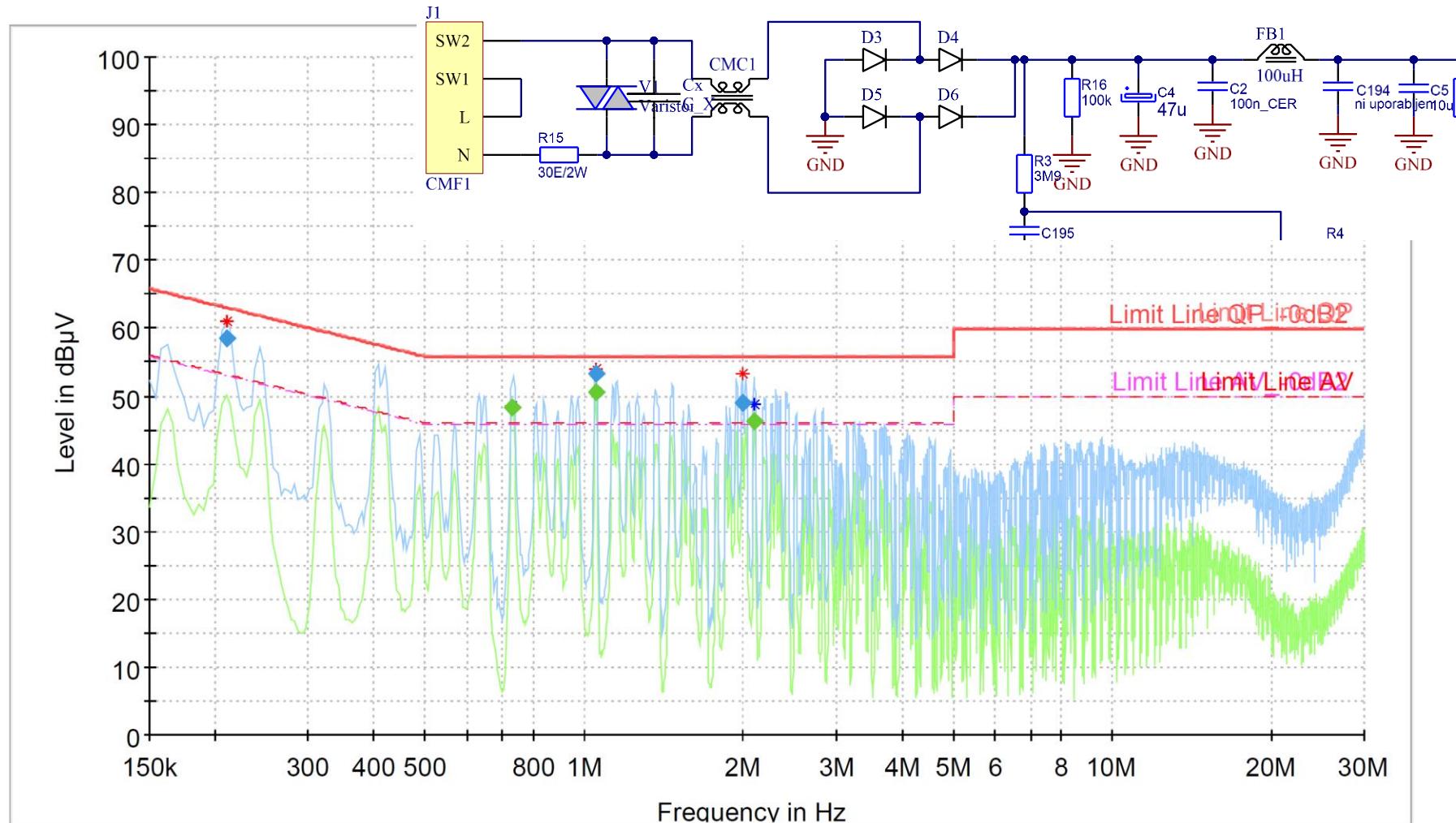
# Jernej Strmec – načrt TIV



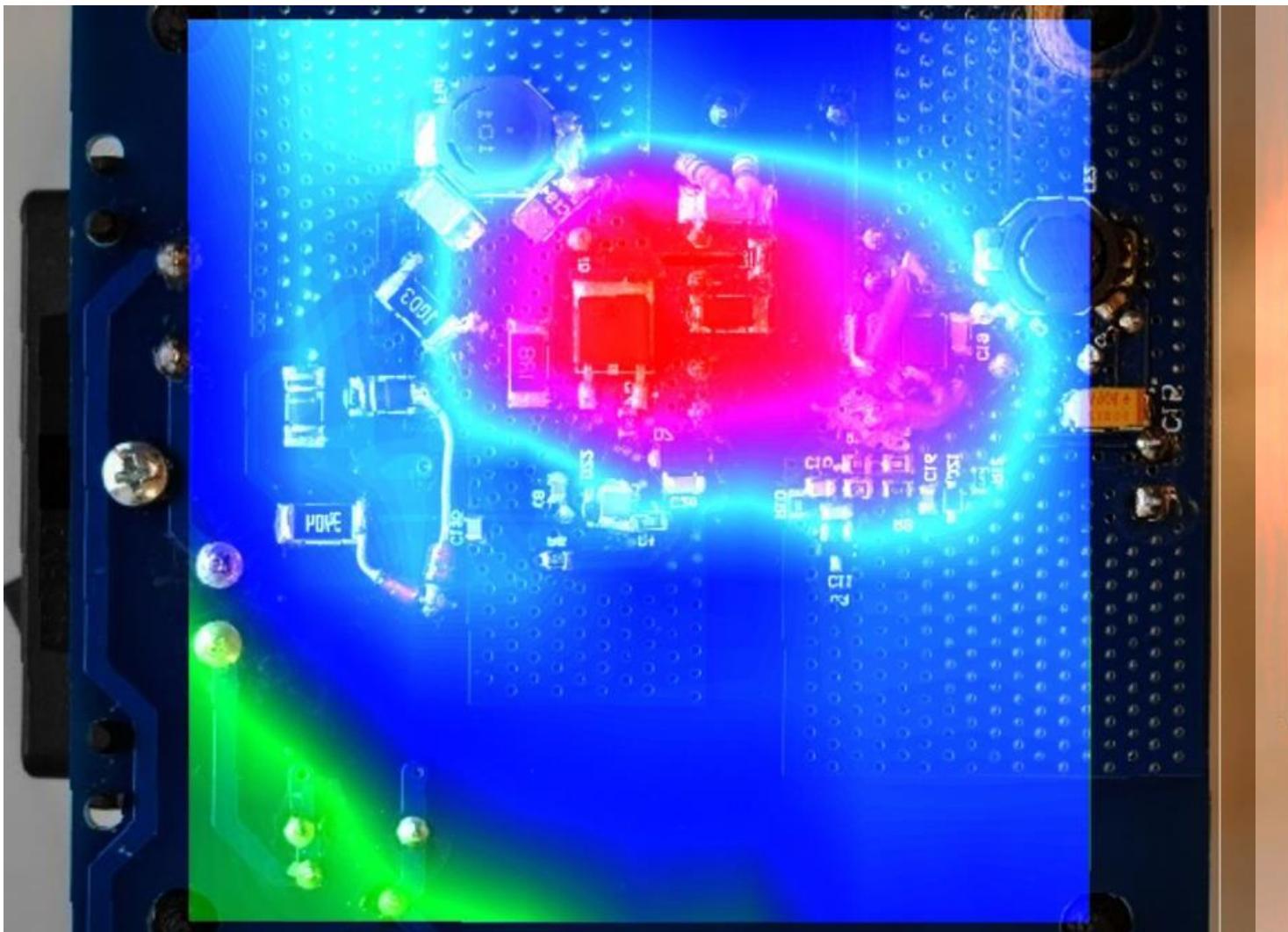
# Jernej Strmec – izdelano TIV



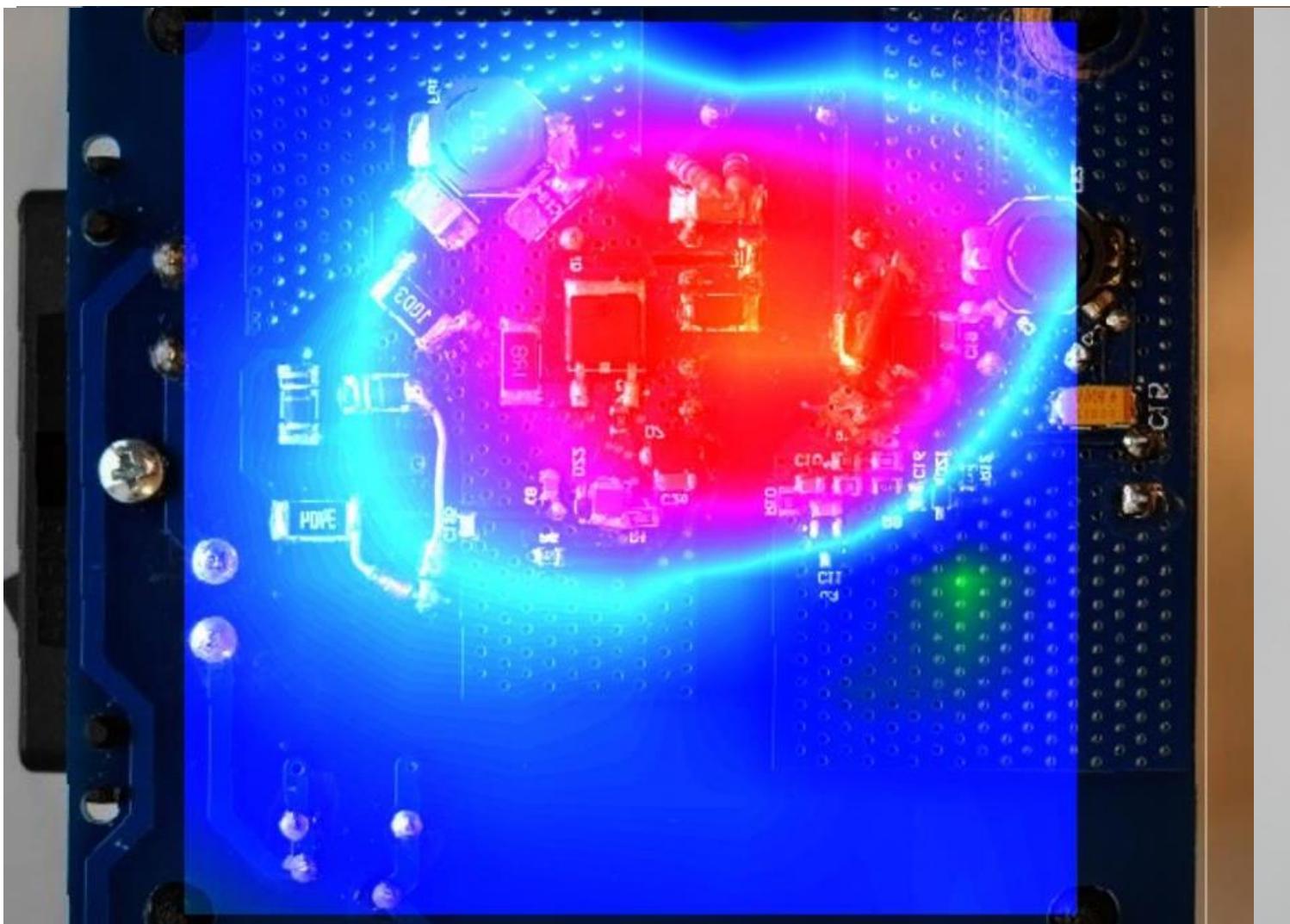
# Jernej Strmec - CE



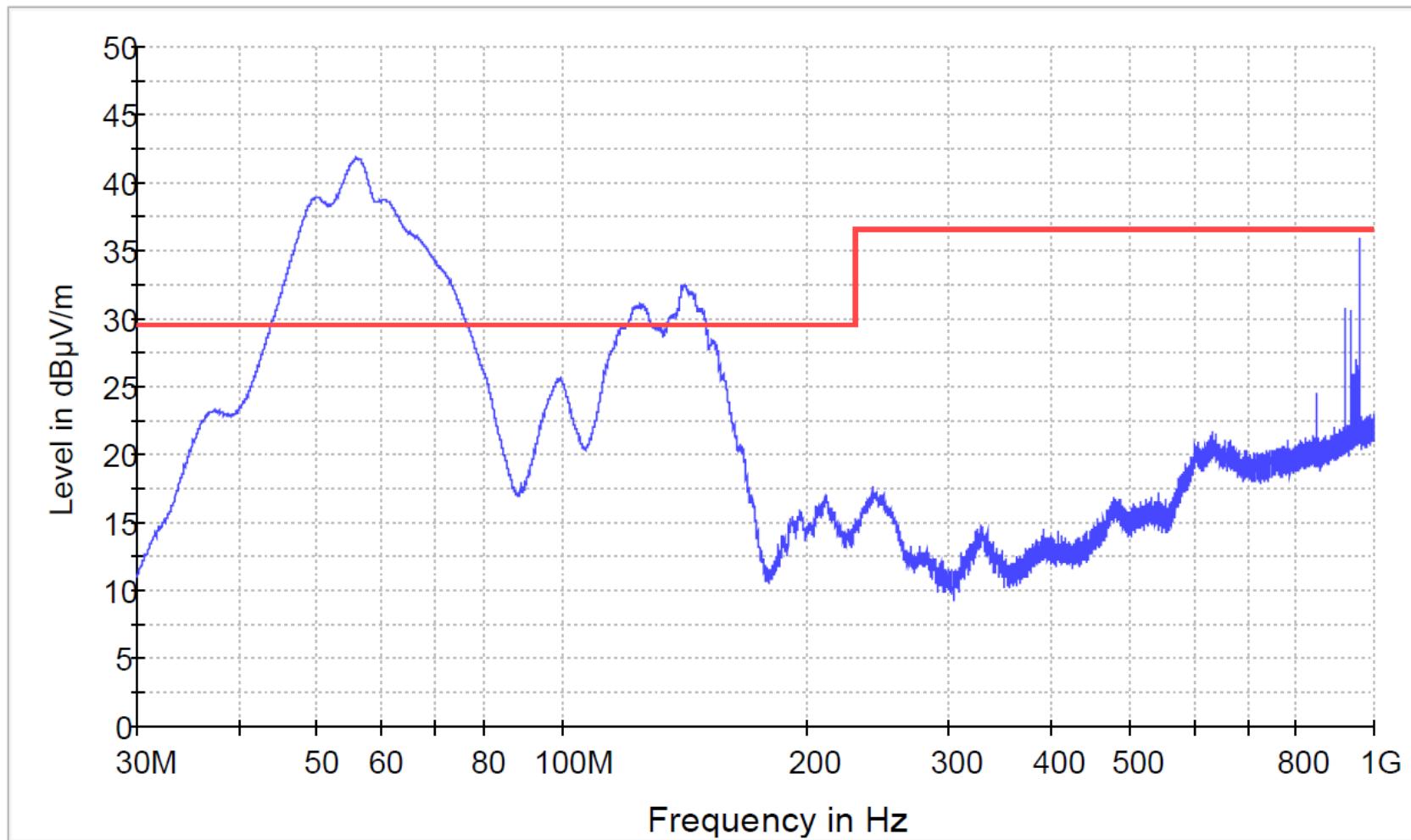
# Jernej Strmec – E 207kHz



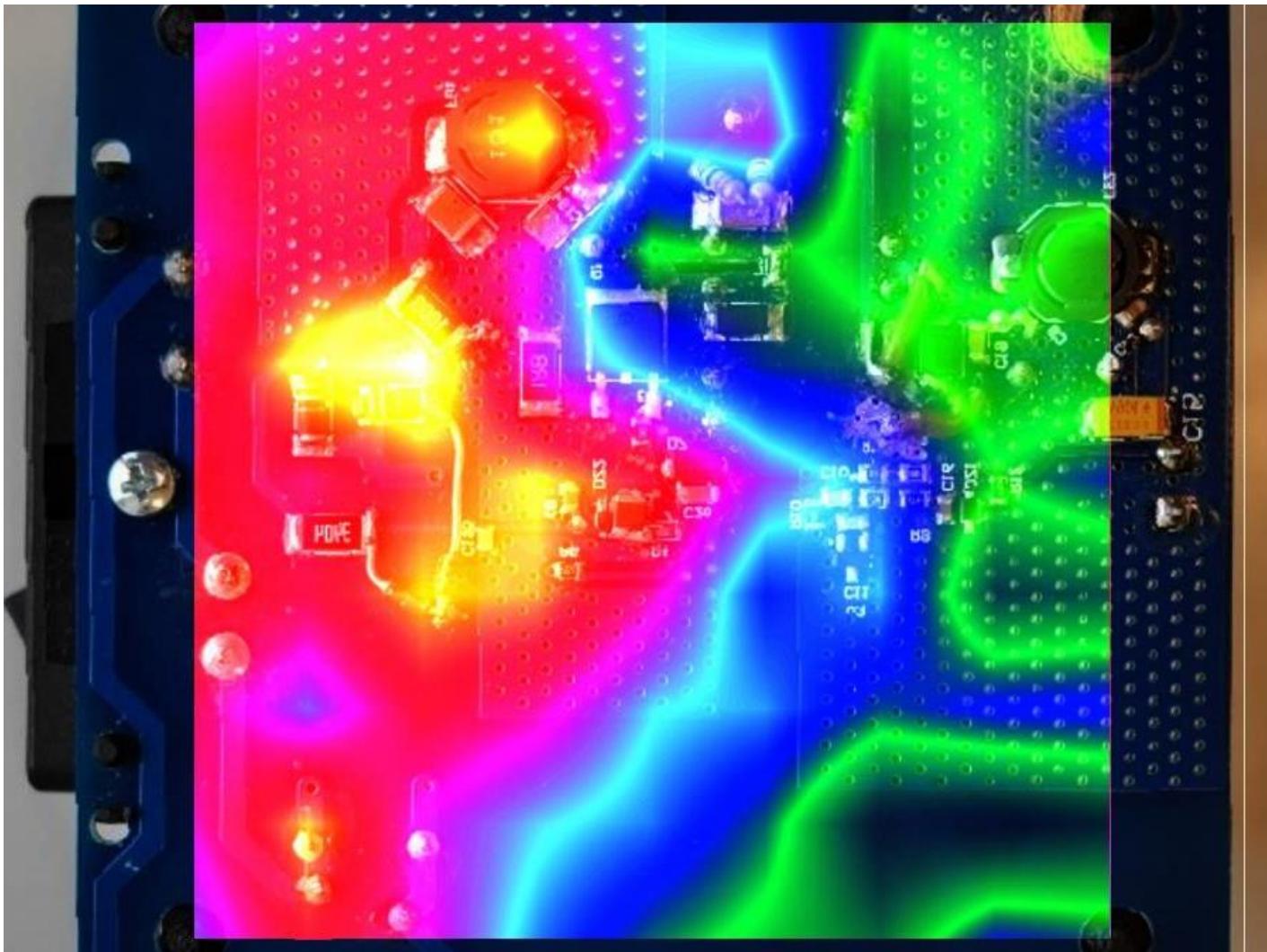
# Jernej Strmec – H 207kHz



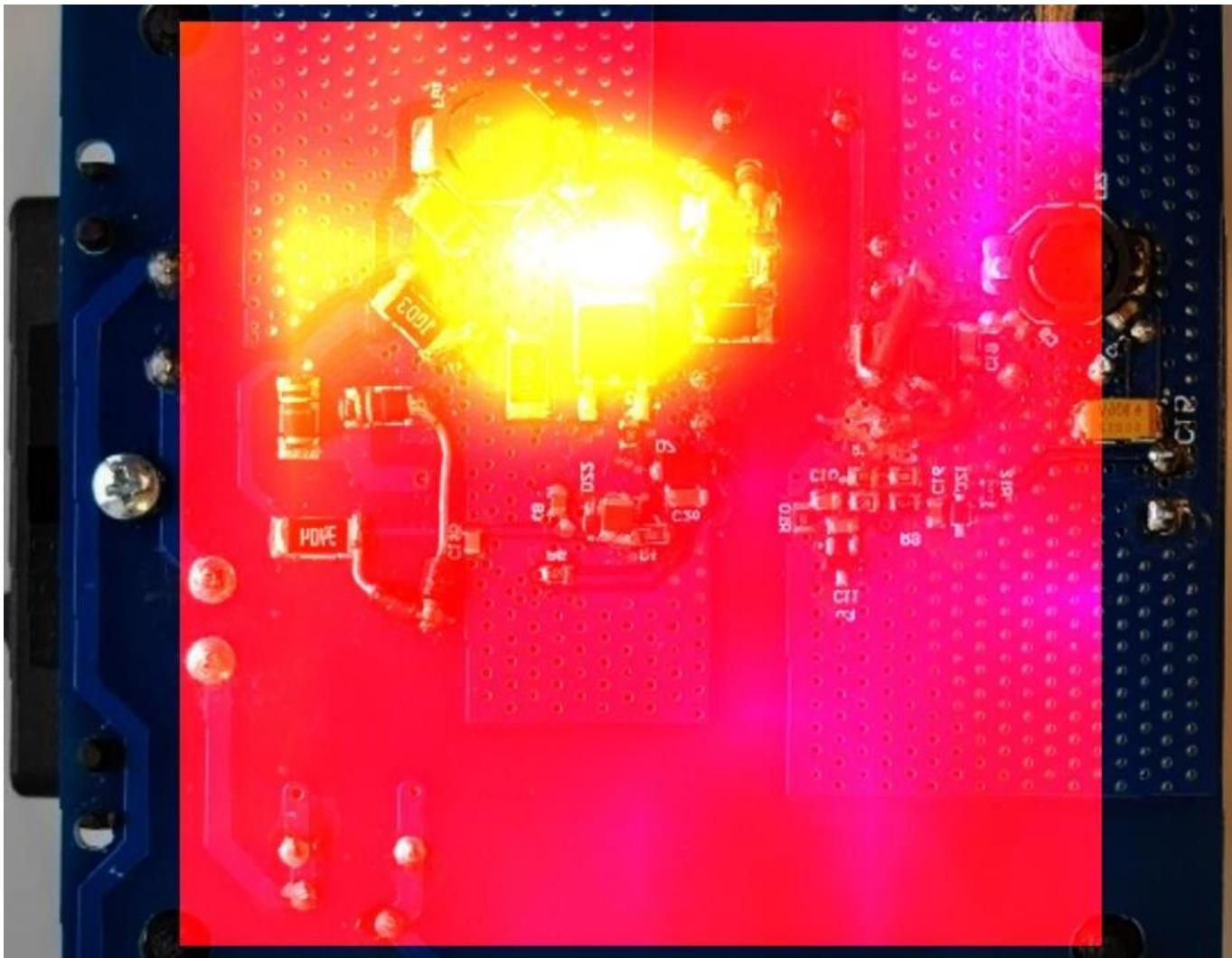
# Jernej Strmec - RE



# Jernej Strmec – E 60MHz



# Jernej Strmec – H 62MHz



# Končni rezultati

Temovalec	Tip tr.	Uizh /0	Uizh 1W	Zagon 1W	Uizh 10W	I	ripple 1W	ripple 10W	HF šum
Igor Strojinc	MOS	20.02	20.02	OK	20.01	0.499	50	10	170
Blaž Strojin	MOS	19.74	19.74	OK	19.7	0.506	23	5	40
Janez Govednik	Bipolarni	20.38	20.35	OK	20.07		300	25	60
Luka Rupar	MOS	20.43	20.41	OK	20.25	0.502	7	10	
Jernej Strmec	MOS	20.37	20.26	OK	20.16		200	20	40
Žiga Korošak	MOS	19.93	19.93	OK	19.91	0.502	350	20	400
Jan Korošec	Bipolarni			OK					

Tekmovalec	Tip vezja	Funkcionalnost				Min dB pod limito			Točke				Rezultat	
		Vklop	KS	Uout	VF šum	CE	RE	OP	T CE	T RE	Surge	Vsota	Mesto	
Igor Strojinc	MOS	OK	OK	OK	OK	5.56	17	10	5.56	10	0	6.9	1	
Blaž Strojin	MOS	OK	OK	OK		-4.43	14	10	-4.43	10	0	4.4	2	
Janez Govednik	Bipolarni	OK	OK	OK	OK	-5.03	4	10	-5.03	7	0	3.5	3	
Luka Rupar	MOS	OK	OK	OK	OK	-7.45	2	10	-7.45	2	0	1.6	4	
Jernej Strmec	MOS	OK	OK	OK	OK	-4.88	-12	10	-4.88	-12	0	-1.2	5	
Žiga Korošak	MOS	OK	OK	OK	OK	-6.16	-11	10	-6.16	-11	0	-1.3	6	
Jan Korošec	Bipolarni	Fail	Fail	Fail	Fail			0	0	0	0	0.0	7	

# Nagrade

500 €

300 €

200 €

2 uri meritev v  
EMC laboratoriju  
SIQ, vremenska  
postaja

Energy Harvesting  
Demokit Solution  
To Go

Keysight  
multimeter v  
vrednosti 200 €

2x Silabs razvojna  
plošča

# Načrtovanje elektronike za EMC



Univerza v Ljubljani  
Fakulteta za elektrotehniko  
Katedra za elektroniko



Laboratorij za fotovoltaiko  
in optoelektroniko

ISKRAEMECO + -



KEYSIGHT  
TECHNOLOGIES



Texas Instruments



## vsako sredo ob 17h v P3-C0

Hvala vsem!